The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D., F.A.C.S.

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The Rationale of Suture Use

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THERE are three mechanical aspects of suturing which must be adjusted to the thread and tied strengths of sutures. These are (1) the ability of the tissues to hold tied sutures; (2) the amount of tissue tension created by suturing; and (3) the tying of the knot.

The characteristic thread strengths of sutures of all sizes and varieties are reduced by tying. Yet these tied strengths usually exceed the ability of tissues to hold them. In fact, when a sufficient number of interrupted sutures are employed, the ability of the wound edges to hold the sutures determines the strength of the wound.

When the wound edges lie together before suturing, little or no tissue tension exists. The function of the suture under these circumstances is to prevent their separation again during healing of the wound. On the other hand, when the edges of the wound are separated, approximation by sutures creates tissue tension and a constant lateral pull on the tissues at the points where the sutures pass. The wider the separation of the wound edges, the greater becomes this pull. If this pull is excessive, tissue necrosis results and the tissues lose their ability to hold the sutures.

Setting of the knot also becomes more difficult when the wound edges are separated. Therefore, if a suture breaks while being tied under this circumstance, it does not necessarily indicate that the strand has insufficient strength to hold the wound edges together. For example, size O catgut has a tied strength superior to the retentive power of most tissues, and yet the first strand or two may break when being tied under tension. The suture simply may not have a margin of thread strength sufficient to satisfy the mechanics of tying in the particular situation. The same problem may arise when a suture must be tied in a deep recess. To use a larger size may satisfy the mechanics of tying the knot, but the larger size contributes no additional strength to the wound, and in fact leaves behind an excessive amount of foreign body capable of delaying wound healing and pre-disposing to infection.

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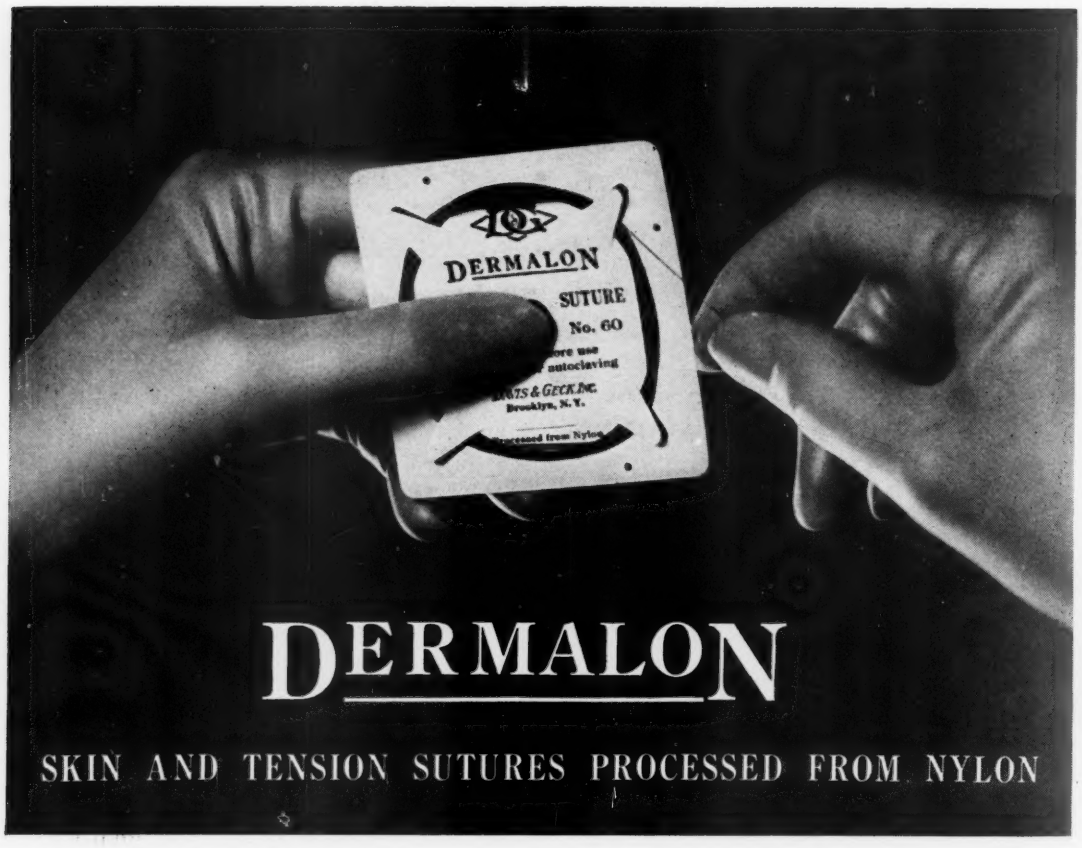

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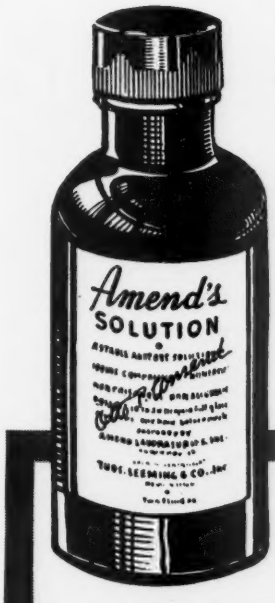

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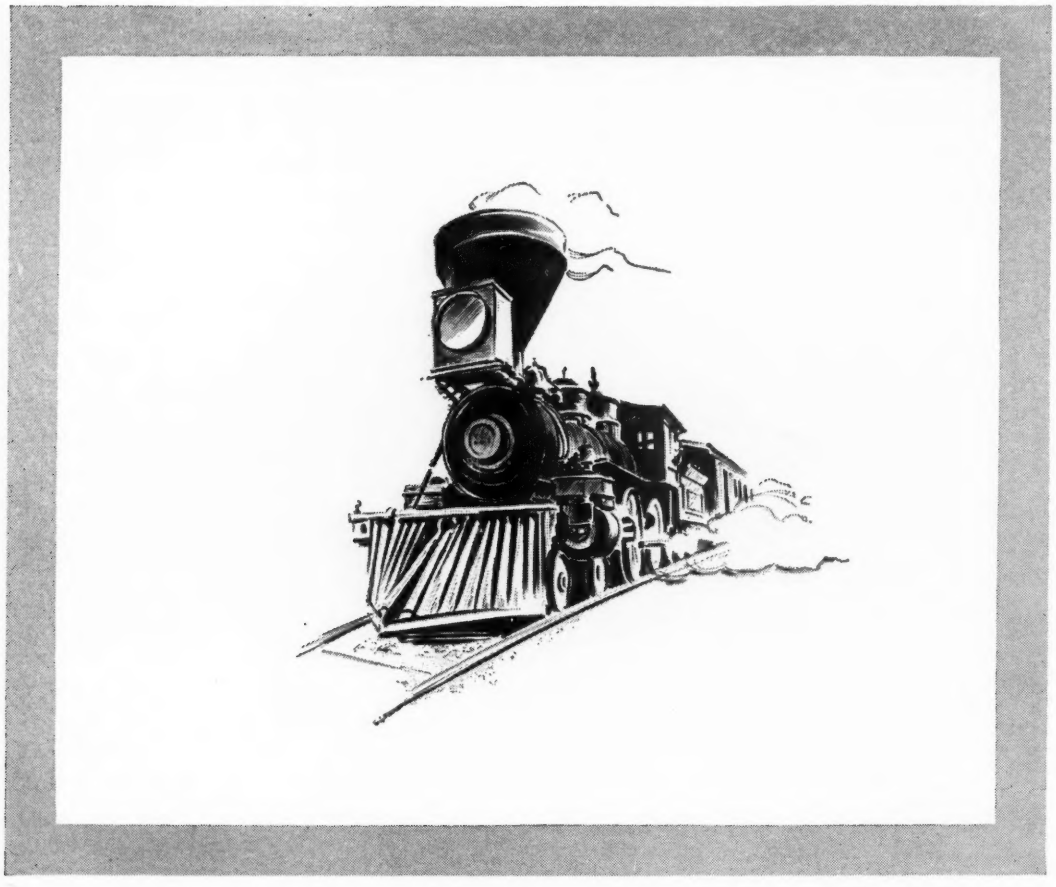

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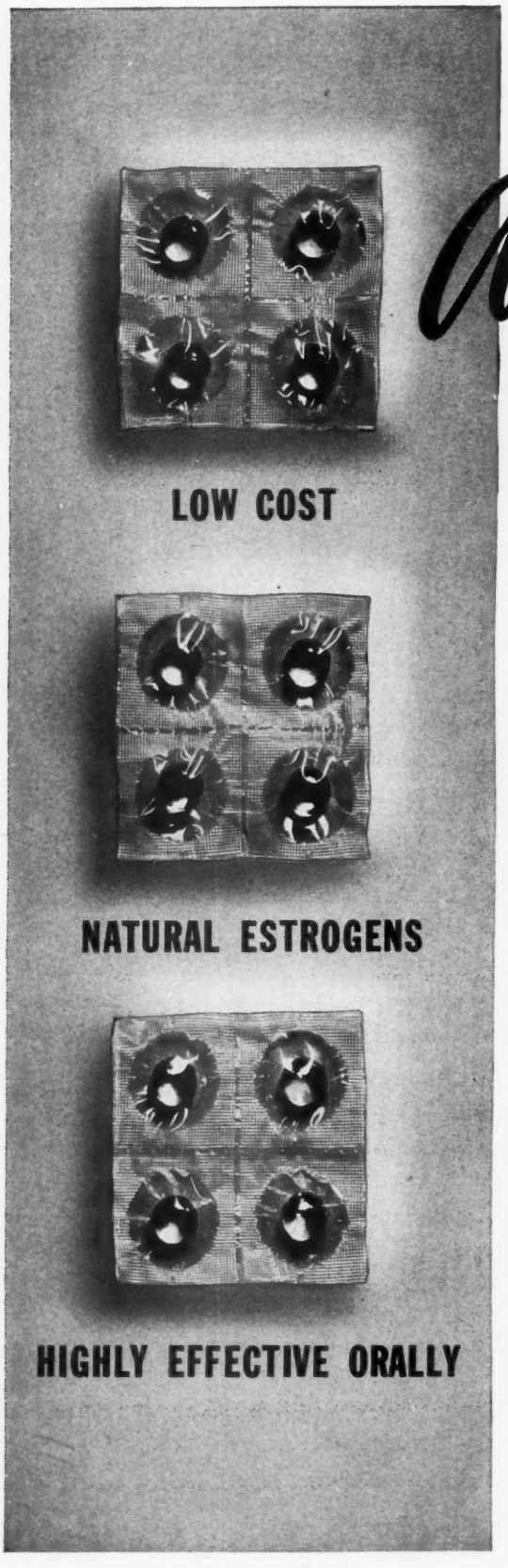

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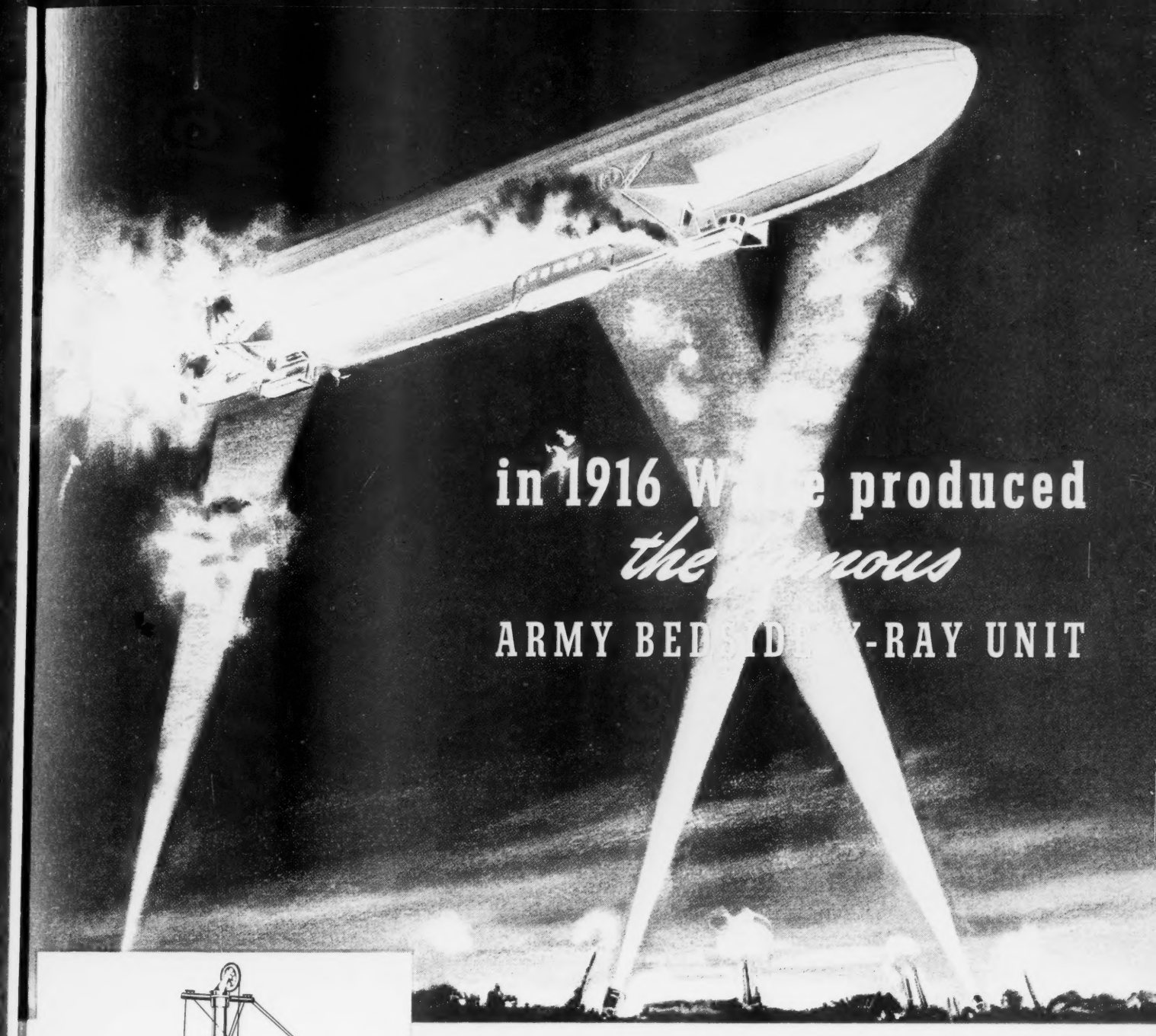

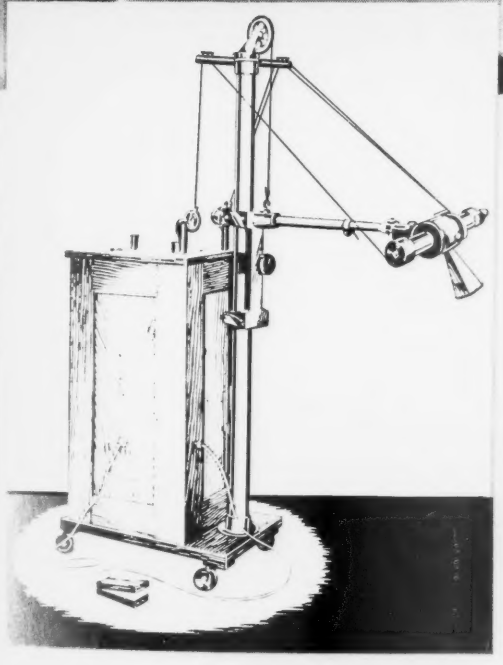

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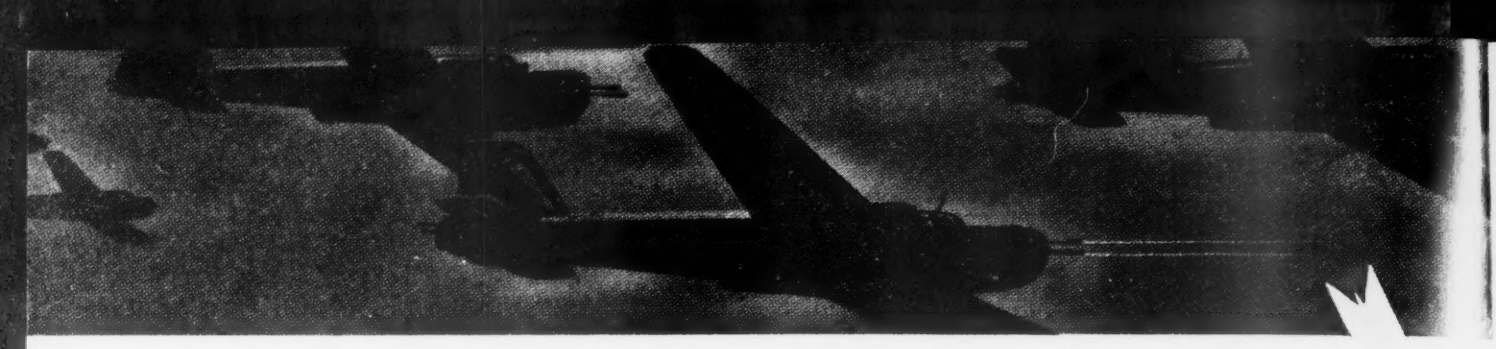

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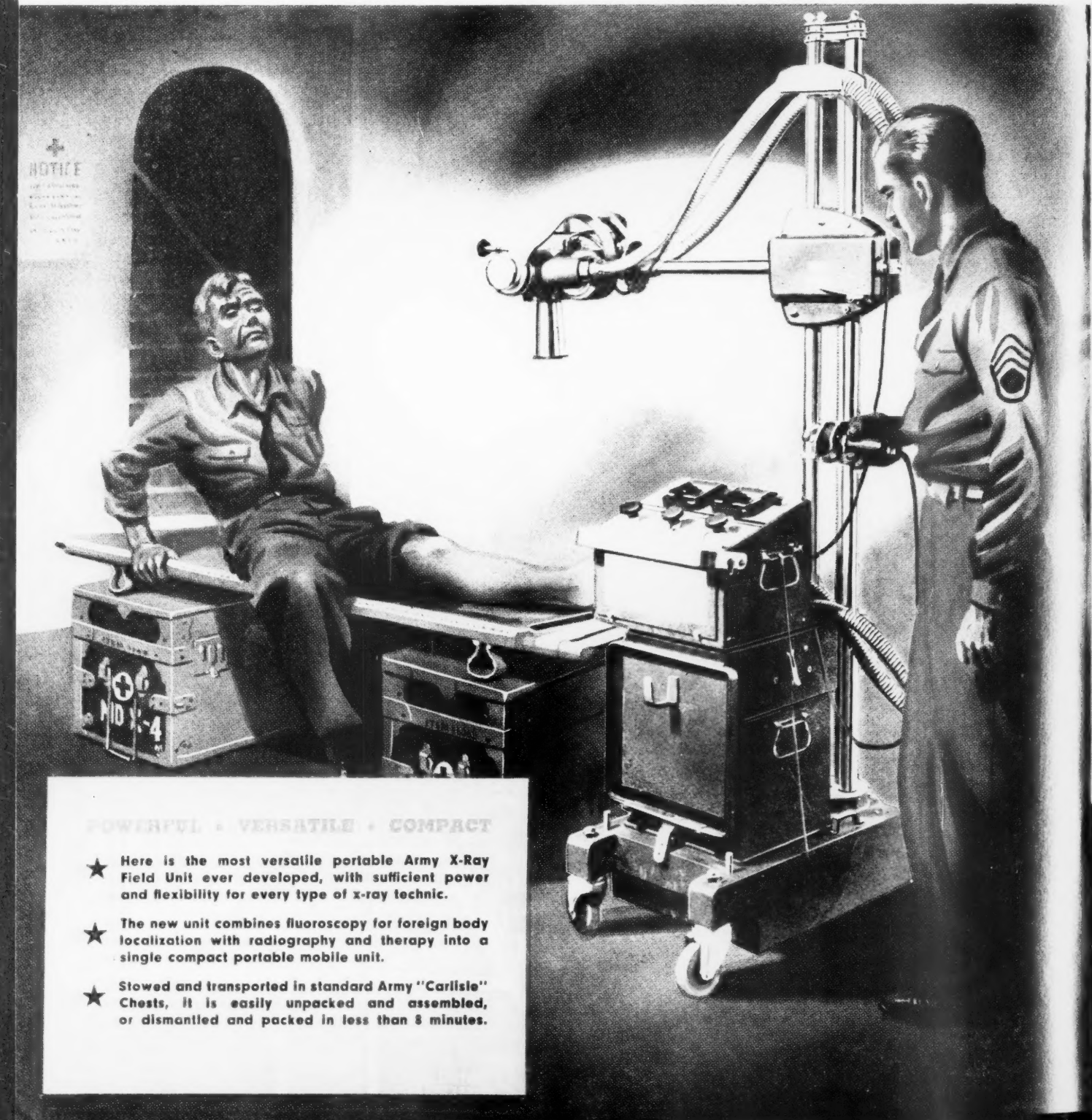

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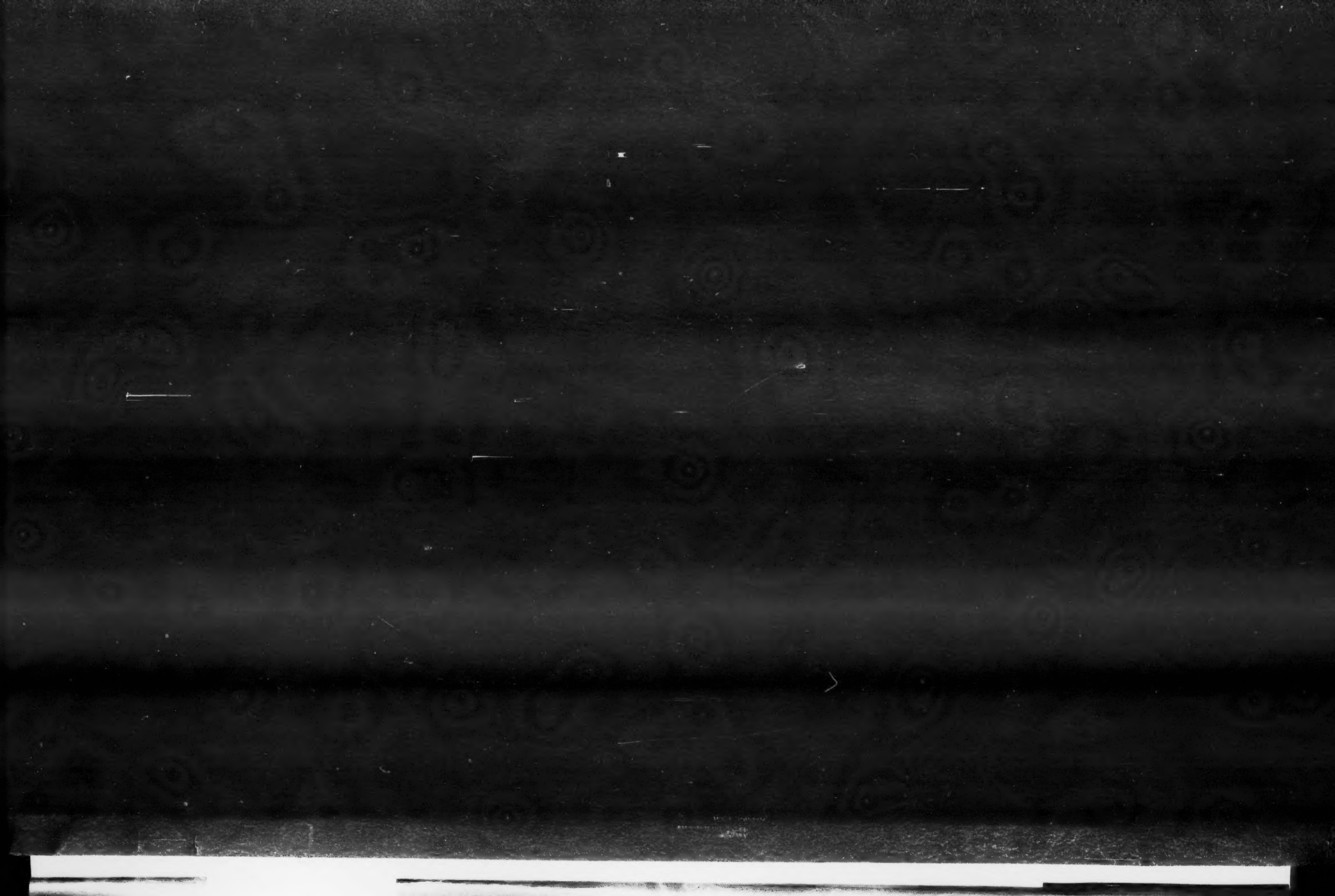

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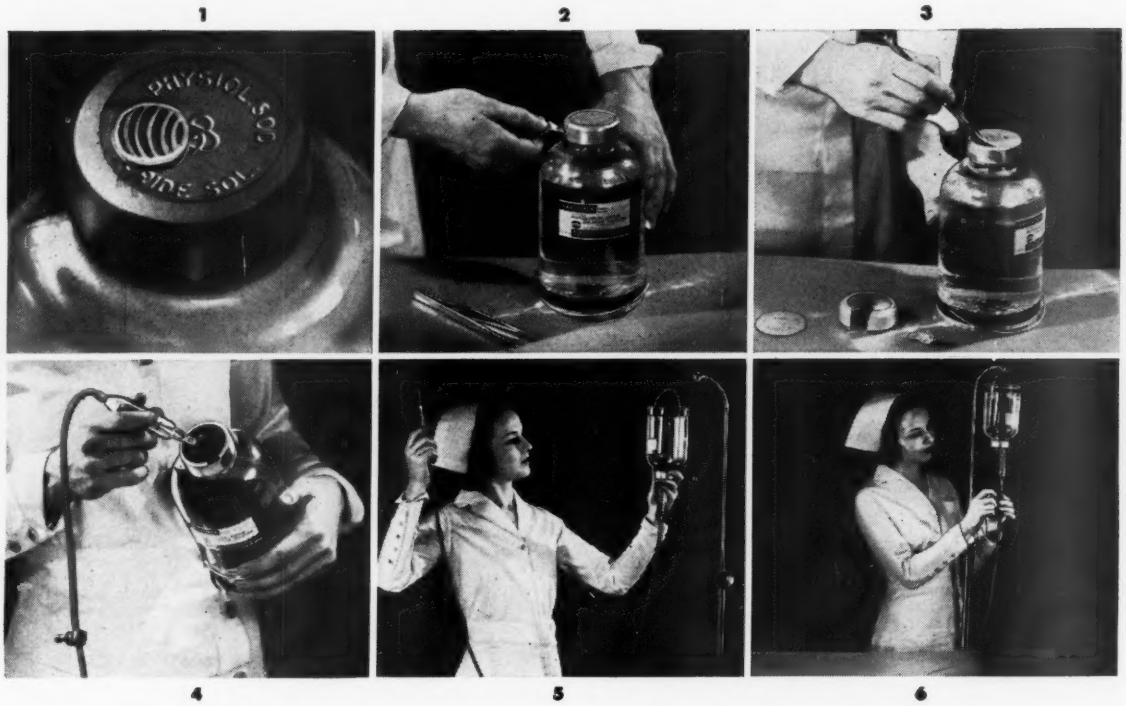

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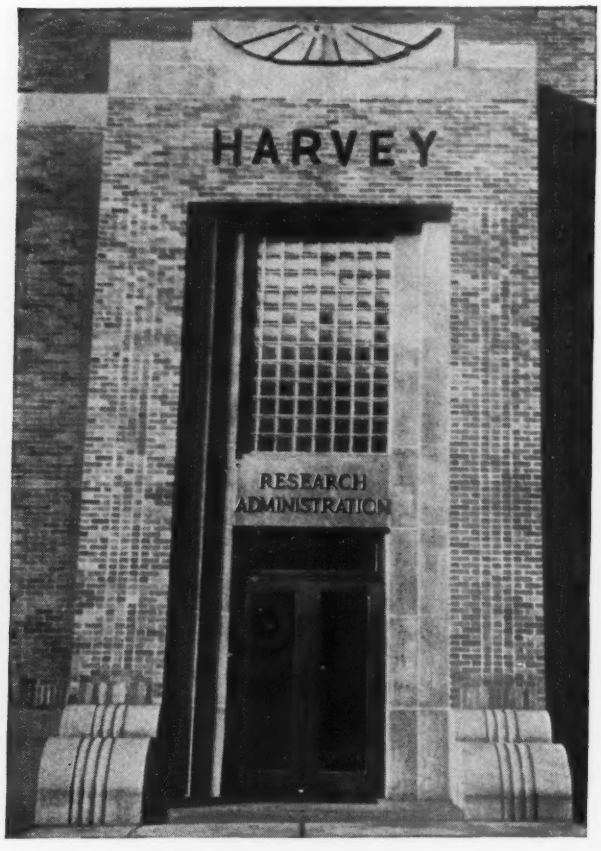

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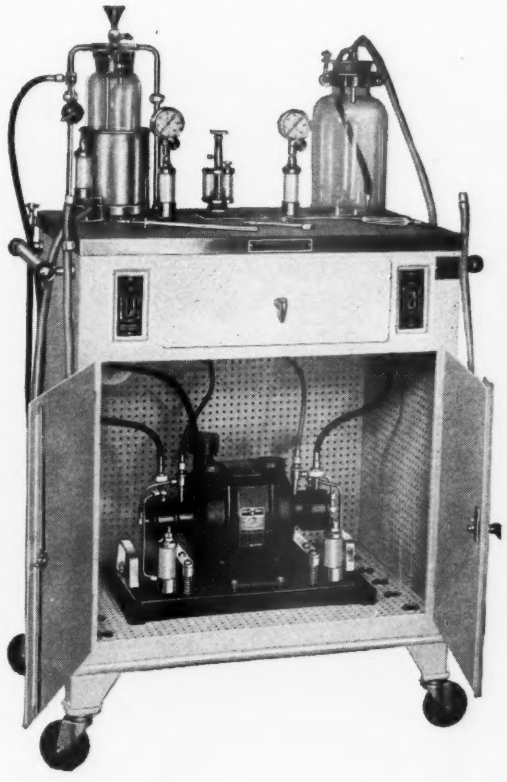

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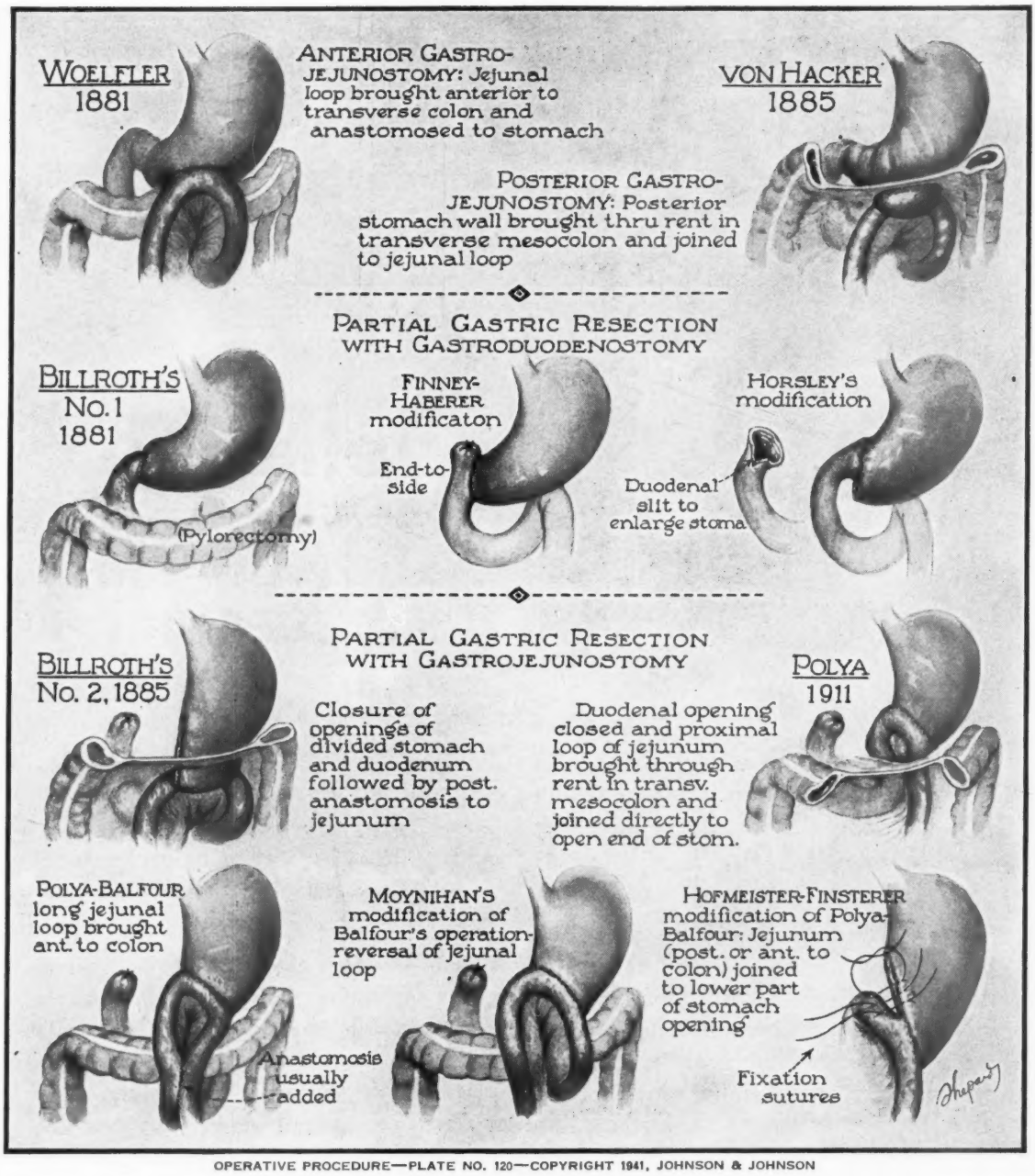
WOELFLER
1881
ANTERIOR GASTRO-JEJUNOSTOMY: Jejunal loop brought anterior to transverse colon and anastomosed to stomach
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POSTERIOR GASTRO-JEJUNOSTOMY: Posterior stomach wall brought thru rent in transverse mesocolon and joined to jejunal loop
PARTIAL GASTRIC RESECTION WITH GASTRODUODENOSTOMY
BILLROTH'S
No. 1
1881
(Pylorectomy)
FINNEY-HABERER modificaton
End-to-side
HORSLEY'S modification
Duodenal slit to enlarge stoma
PARTIAL GASTRIC RESECTION WITH GASTROJEJUNOSTOMY
BILLROTH'S
No. 2, 1885
Closure of openings of divided stomach and duodenum followed by post. anastomosis to jejunum
Duodenal opening closed and proximal loop of jejunum brought through rent in transv. mesocolon and joined directly to open end of stom.
POLYA
1911
POLYA-BALFOUR long jejunal loop brought ant. to colon
Anastomosis usually added
MOYNIHAN'S modification of Balfour's operation-reversal of jejunal loop
HOFMEISTER-FINSTERER modification of Polya-Balfour: Jejunum (post. or ant. to colon) joined to lower part of stomach opening
Fixation sutures

OPERATIVE PROCEDURE—PLATE NO. 120—COPYRIGHT 1941, JOHNSON & JOHNSON

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NEW SERIES VOL. LIII AUGUST, 1941 NUMBER TWO

Editorial

ANESTHESIA AS AN ART

"SCIENCE IS SYSTEMITIZED KNOWLEDGE—ART IS KNOWLEDGE MADE EFFICIENT BY SKILL." J. G. GENUNG

THE recent resuscitation of the field of anesthesia through the various organizations by which it is being brought to the attention of the medical profession and the public, suggests an appraisal of the final objective to be achieved.

Is the major emphasis to be placed upon research or upon practice, upon the science or upon the art? Are both research and practice to be confined to a strictly professional personnel? Is the technician to be accepted or rejected?

The present practice of every hospital, large and small, of indulging indiscriminately in research, employing each new drug as it appears in medical and commercial literature, may be interesting and stimulating to the medical anesthetist who is obliged to spend many hours in routine supervision, but does the final result in reduced morbidity and mortality justify such emphasis? It would seem that research should be concentrated in the clinic possessing well equipped, specially trained personnel, having a large volume of well supervised clinical material and possessing facilities for careful postmortem checking.

Lack of mechanical skill or knowledge on the part of the anesthetic personnel is frequently transferred to equipment designed to cover all shortcomings. It is easier to teach the management of equipment than it is to supply the pathological physiology which should serve as a guide to the anesthetist. The variations which regularly occur on the part of the physiological mechanism and its failure to fit into a predetermined pattern, are lost in the relatively large volume of satisfactory results. Science appears satisfied to turn out mechanics rather than physicians trained to use lethal drugs for the relief of the desperately ill patient. Emphasis is placed upon machinery rather than the unique physiology involved. The patient is expected to demonstrate the particular virtues of a drug or a technic by surviving exposure to it. Should not the drug and the technic be selected to contribute to the patient's margin of safety?

Let us consider briefly the distinction between the science and the art of anesthesia.

Science is concerned with systematized knowledge and is satisfied with knowledge as its goal. The science of anesthesia implies a knowledge of physiology and anatomy, of blood chemistry and of reflex arcs, of the pharmacology of drugs and the behavior of gases; knowledge of the latest equipment

and its particular advantages; knowledge of the history, the development and the practice of regional, epidural and sacral block and the best method of spinal anesthesia; knowledge of basal anesthetics and their indices, of antidotes and of analeptics; knowledge of pathological physiology and its specific bearing upon anesthetic drugs; knowledge of the circulation as a channel through which intravenous drugs may function; knowledge of fire hazards and of all the means suggested to reduce the incidence of explosion; knowledge of the mechanics of respiration and of the means of meeting violations of intra- and extrapulmonary pressure in operations upon the open chest; knowledge of the surgical procedure involving the respiratory airways, the specialities, obstetrics, the brain and the heart; and knowledge of anoxia, its historical background, its blood chemistry and modern methods of relief.

A man may be an expert in the science of anesthesia, and yet, given a patient, a can of ether and a towel, can he anesthetize such a patient for even a minor procedure, or given a tank of nitrous oxide or oxygen with a couple of yolks, rubber tubing and a mask, can he satisfactorily administer a gas oxygen anesthesia?

Of what value is the science of anesthesia to the patient, to the surgeon or to the anesthetist unless, in addition to accumulating information, the anesthetist has achieved success in developing discriminating judgment which will permit him to appraise his environment, the qualifications and limitations of the operating surgeon and the least dangerous of the hazards which the patient must face. Of what worth is this science unless the anesthetist can estimate resistance to surgery and to exposure by the feel of the tissues, the response of the reflexes; unless he can see pallor before the sphygmomanometer records it; unless he can react to anoxia before the surgeon informs him that the patient's blood is black; unless he can discard the latest type of gas machine for a tank of oxygen with a yolk and rubber tubing as occasion offers; unless he be free of the hazard of faulty equipment and independent of precision adjustments designed to do his work for him and calculated to free him to record the story of the patient as it progresses. (Has a surgeon ever been known to interrupt his procedure to write about it, making the record more important than the surgery?)

An anesthetist is not a worthy practitioner of the art unless while knowing one anesthetic agent with the familiarity of long use he may leave it freely for another when the indication arises; unless he has learned one technic so well that he has taught it to meet the various problems which continually arise; unless he is familiar with the margin of failure to be encountered in local, regional and spinal methods and is willing to face the postoperative sequelae occurring in the last; unless he is willing to refuse to use basal anesthetics when these increase the hazard to the patient; unless he is willing to forego the ease of induction implied by premedication for better subsequent control of the patient; unless he insists that safety must come before comfort and has come to realize through his own and the experience of others that dependence cannot always be placed on antidotes; unless he has seen what may take place when gas is given to an infection of the neck and avertin or evipal for operations upon the jaw; unless he is prepared to meet the postoperative excitement of intravenous barbiturates and is familiar with the operative field which may be expected when moderate dosage is adhered to.

He does not place safety first unless he understands that the use of certain gases are intrinsically dangerous, that human nature, being what it is, all precautions will not be cared for; slips must occur; unless he is willing to substitute for such gases others known to be flammable but not at all likely to explode, even in the most exposed environment. Unless he is familiar with the facts that oxygenation of the chest case is *the* important factor; that the

mechanism of ventilation takes precedence over the anesthetic agent selected; unless he can recognize asphyxia when he sees it and is able to eliminate the death zone of the respiratory tract without calling upon the surgeon for help; unless he knows what the special fields of surgery under operation actually requires; i.e., the extent and the amount of relaxation, the control of reflexes, hemorrhage and the maintenance of asepsis; unless, in short, he is capable of putting into practice his scientific knowledge to the end that he may secure as smooth and as rapid an induction as conditions permit, a maintenance under complete control and a recovery free from immediate and remote effects.

The foregoing suggests that a true conception of the art of anesthesia implies a first class medical background. Anesthesia as an art is an evolution of the basic medical sciences from which the education of the physician anesthetist takes its source.

Technical workers may accumulate an assortment of revelant facts bearing upon the subject, but can no more create or judge than can the laboratory worker in other medical specialties.

"*Art is knowledge made efficient by skill.*"

Routine anesthesia limited to a fixed field, under constant conditions as to agent, technic and operating personnel does not require basic scientific knowledge. A few, well considered rules yield a satisfactory background. In such team-work, the skilled artisan may be developed—a technician skilled in a limited field of the art.

Such a technical artisan, supported and directed by a routine group will give a better anesthesia and will contribute to a better result, than the medical man familiar with the science of anesthesia but a stranger to the art.

It follows, therefore, that the physician who practices the art of anesthesia is familiar with its science. He is quick to seize upon any new agent or technic which promises him a more finished work. Conversely, he is slow to abandon old and familiar tools for others whose chief purpose is to make up for the lack of skill on the part of "the many."

The strictly supervised technician has a place in the hospital mass production problem, but only skilled artisans should be employed in this capacity. Deficiencies in skill may be made up in part by mechanized equipment. The glamor of the science of anesthesia, featuring novelty in drugs and gases and made impressive by costly equipment should not overshadow the reason for its existence "as an art" to make better surgery possible. The patient who is about to undergo an operation is the focal point about which all other factors must be made to turn. The anesthetic and the apparatus are merely tools for the accomplishment of a smooth and safe anesthesia. To make such tools complicated and impressive is to draw critical attention away from the patient. Simple tools have always been the mark of a true artist. Simplicity of mechanical approach, capable of producing a desired result, gives freedom and elasticity of control and by passing into the background of attention, allows interest to be directed exclusively to the vital phenomenon of life.

It is hoped that from the many who are familiar with the science of anesthesia there will, in the course of time, be evolved more and more physicians who may be referred to as worthy practitioners of the art.

Paluel J. Flagg, M.D.

See Color Section between pages 322 and 323.

Original Articles

THE LE FORT COLPOCLEISIS*

AN ANALYSIS OF THIRTY-ONE CASES WITH A DESCRIPTION OF THE TECHNIC USED BY THE AUTHORS

CONRAD G. COLLINS, M.D., F.A.C.S. AND FRANK R. LOCK, M.D.

Assistant Professor of Gynecology, Tulane University, of Louisiana

Associate Professor of Gynecology and Obstetrics, Bowman-Gray School of Medicine, Wake Forest University Winston-Salem, North Carolina

NEW ORLEANS, LOUISIANA

PROLAPSE of the uterus, or of the vagina following hysterectomy, in aged or elderly women though not endangering the patient's life, produces many annoying symptoms. A sensation of heaviness in the pelvis, and bladder symptoms, such as incontinence, dysuria and frequency, as well as local discomfort are frequently present. Many of the patients have associated medical conditions, namely hypertension, mild cardiac disease, diabetes or nephritis. These complications increase the surgical hazard for major operations such as vaginal hysterectomy or extensive plastic procedures. For this reason, the majority of these patients have been treated in a palliative manner by means of pessaries. However, the marked relaxation producing the cystocele or rectocele which usually accompanies complete prolapse, frequently prevents satisfactory utilization of a pessary to overcome the prolapse. In addition, the necessity of repeatedly having the pessary removed, cleansed and reinserted is objectionable. Any operative procedure that is devoid of all but a minimal amount of risk, that can be rapidly performed and that will produce lasting and satisfactory results is ideal for this condition. The Le Fort Colpocleisis, which fills these requirements, is of proven value in this type of case.

This report is concerned with a critical analysis of thirty-one cases of genital prolapse, treated by means of the Le Fort procedure by nine members of the teaching staff of the Department of Gynecology of Tulane University in the public wards of Touro Infirmary and Charity Hospital of New Orleans, together with cases taken from the private practice of one of us. All members of the department do not use exactly the same technic. The majority follow the technic as set forth by Le Fort with the addition of a high perineal repair. The authors believe that more adequate support is obtained by also approximating the pubocervical fascia and levator fascia to each other. A description of the technic used by the authors is outlined later.

Of the thirty-one cases, eight patients, or 26 per cent had had a previous hysterectomy (seven abdominal, one vaginal), and complete prolapse of the vaginal vault was present. In another instance, a plastic operation and laparotomy had been performed in 1922; another had an application of radium in 1929. Thus a total of 32.5 per cent had previous gynecological operations. Of the entire group, twenty-five patients

* From the Department of Gynecology, Tulane University of Louisiana; Charity Hospital and Touro Infirmary at New Orleans, Louisiana.

had complete prolapse (84.5 per cent), in five cases, though incomplete, the prolapse structures appeared at the vulva.

AGE

The youngest patient in the group was forty-eight years of age, the eldest seventy-eight. There were four women between the ages of forty-five and fifty-five (13 per cent), twelve patients between fifty-five and sixty-five (39 per cent), eleven patients between sixty-five and seventy-five (35 per cent) and five patient between seventy-five and eighty, (13 per cent). Forty-eight per cent of the patients were over sixty-five years of age.

COMPLICATING FACTORS

Twenty-five patients (80.5 per cent) had hypertension as a complicating factor. Of these, seven had systolic blood pressures ranging between 140 and 150 (19.5 per cent); in twelve, the systolic blood pressure ranged between 160 and 180 (39 per cent); in three, the systolic pressure ranged between 180 and 200 mm. Hg. (9.7 per cent). In two patients, the systolic blood pressure was over 200 mm. Hg. (6.5 per cent). Four patients had hypertensive cardiovascular disease, grade 2A (13 per cent), and one patient had severe diabetes with hypertensive cardiovascular disease (3.25 per cent).

SYMPTOMS

The most frequent complaints of the patients were pain in the lower abdomen, a sense of fullness and pressure in the vagina, local discomfort, dysuria, incontinence and frequency of urination. Thirty of the thirty-one patients (96.75 per cent) complained of lower abdominal pain, described a sensation of weight in the pelvis and local discomfort in the perineum. Sixteen (51.6 per cent) complained of dysuria, and twenty-two (71.5 per cent) complained of incontinence of urine on laughing, coughing, straining or sneezing. Two patients of the group had complete incontinence of urine. Frequency was noted in twenty-one cases (68.25 per cent).

HOSPITAL STAY

The total stay in the hospital of these patients was 522 days, an average of 16.7 days. The total postoperative stay in the hospital was 349 days or an average of 11.2 days for each patient. In many instances, a prolonged preoperative hospitalization was necessary in order to reduce the surgical risk. The shortest postoperative stay was five days, and the longest was thirty-three days.

ANESTHESIA

In sixteen cases local anesthesia was used (51.6 per cent), thirteen patients were given gas anesthesia (41.9 per cent), and two patients a spinal anesthesia (6.5 per cent). Local infiltration is the authors' choice of anesthesia for this procedure. It is interesting to note that the average operating time when local anesthesia was used was 33.4 minutes, whereas for those patients given gas anesthesia, 41.6 minutes were required to perform the operation. When spinal anesthesia was used, the operations lasted one hour to an hour and twenty minutes. Not only is the operating time approximately the same whether local anesthesia or gas is used, but there is a lessened danger of complications arising in the aged individual when the former agent is used for vaginal operations. Three patients required catheterization following the use of gas anesthesia and only one required catheterization after the use of local anesthesia. This series, of course, is not large enough to confirm our impression that patients given a local anesthesia require less catheterization than the patients operated upon under other forms of anesthesia. Local anesthesia comprises the use of local infiltration of tissue and pudendal block with a 1 per cent solution of novocaine. The patients experience very little or no discomfort throughout the operation.

COMPLICATIONS AND MORBIDITY

Of the entire group of thirty-one cases, only one had a morbid postoperative

course. This patient was given spinal anesthesia and a third degree laceration was repaired at the time of the Le Fort procedure; the operation required one hour and forty-five minutes. This patient had an extremely stormy convalescence. Her temperature ranged to 105°F. and above, and she developed uremia postoperatively, but finally recovered. Of the remaining thirty patients, only three, or 9.75 per cent, had a temperature above 100°F. on any occasion, and none of these exceded 101°F. The remaining 86.75 per cent, twenty-seven patients, did not have a temperature as high as 100°F. on any occasion following operation. In addition to the case described having uremia, one patient operated upon under local anesthesia developed a small rectovaginal fistula which healed spontaneously. In both patients an excellent postoperative result was obtained.

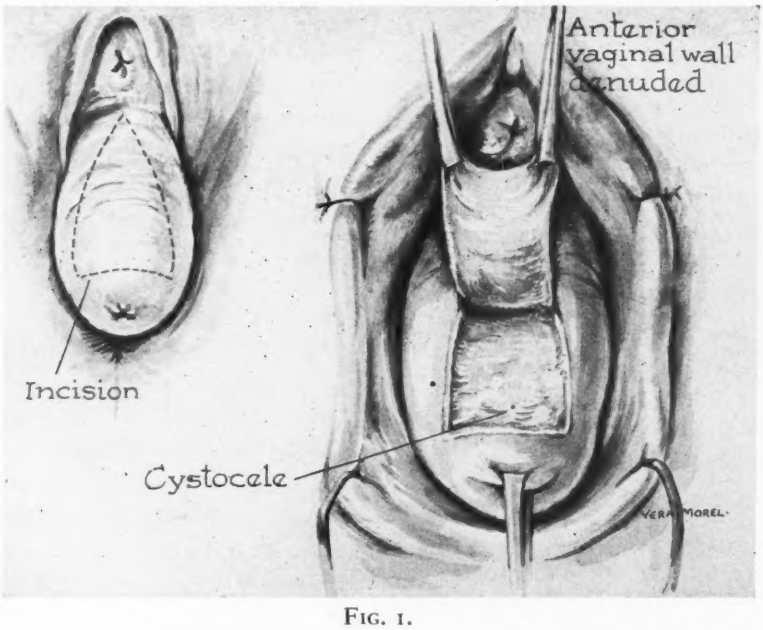

Fig. 1.

PREOPERATIVE PREPARATION

Needless to state, these patients should be placed in the best possible preoperative condition. Aside from general preoperative care the authors believe that the insertion of suppositories containing 2,000 International Units of the estrogenic hormone into the vagina for eight to fourteen days prior to operation, materially increases the blood supply of the vagina and produces a healthy, thicker mucous membrane, thus lessening the danger of infection and facilitating the performance of the operation. A douche containing two tablespoonsful of vinegar to the quart of water should precede the insertion of each suppository.

OPERATIVE TECHNIC

The vagina and vulva are painted with tincture of merthiolate. The apex of the prolapse structures is grasped with the tenaculae (Allis clamps if cervix has been previously removed), and an incision about 2 cm. in length is made horizontal to the apex and approximately 1 cm. from the apex on the anterior vaginal wall through the vaginal mucosa. A similar incision is made posteriorly.

The area to be denuded on the anterior vaginal wall is outlined by two incisions extending through the vaginal mucosa, beginning at the lateral margins of the initial incision on the anterior vaginal wall and continuing parallel to each other to within 2 cm. of the urethral orifice, where they converge to meet each other at a point 1 cm. below the urethreal meatus. All vaginal mucous membrane thus outlined is

removed. The pubocervical fascia is identified and freed from the vaginal mucosa. (Fig. 1.)

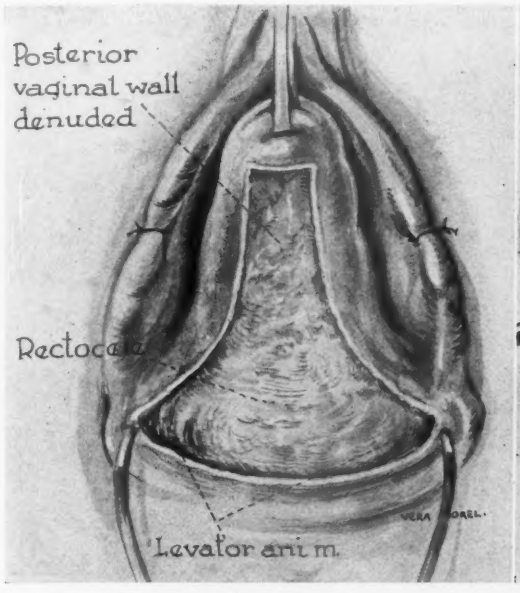

Fig. 2.

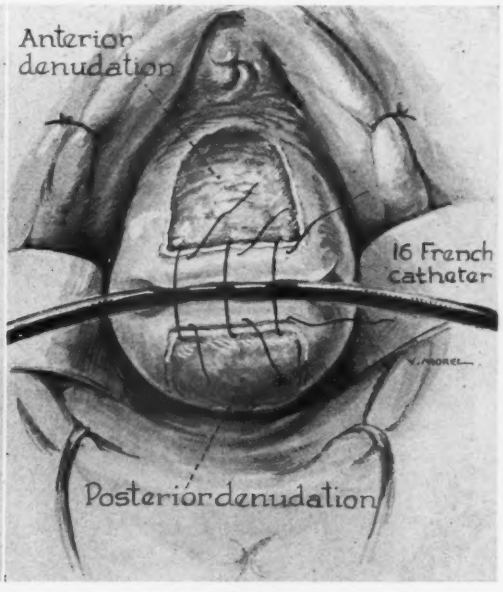

Fig. 3.

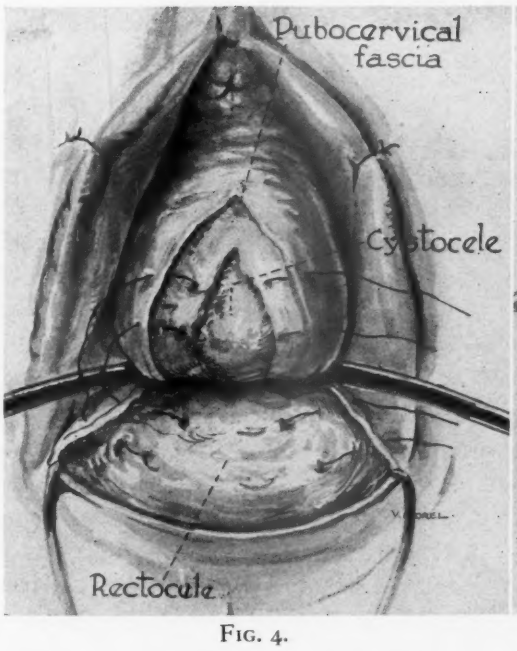

Fig. 4.

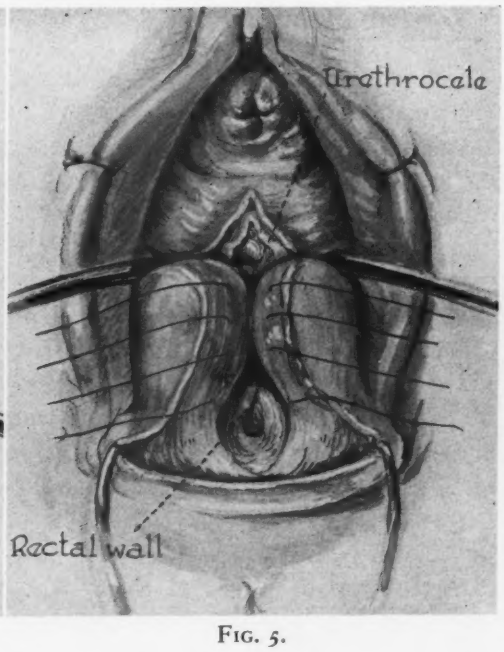

Fig. 5.

The area to be denuded posteriorly is outlined by two incisions (Fig. 2) carried through the vaginal mucous membrane and extending from the lateral margins of the incision made initially in the posterior vaginal mucosa. These incisions extend parallel to each other for a distance of 3 cm. and then diverge laterally to the junction of the lateral and posterior vaginal walls. Another incision, following the mucocutaneous border of the vagina, joins these. The area thus outlined is denuded of vaginal mucous membrane.

A No. 16 French catheter is then placed against the apex of the prolapsed structures. (Fig. 3.) This catheter insures a canal of approximately the same diameter when the operation is completed and also serves for traction when necessary. Three

interrupted sutures join the anterior border and posterior border of the mucous membrane paralleling the apex of the structures.

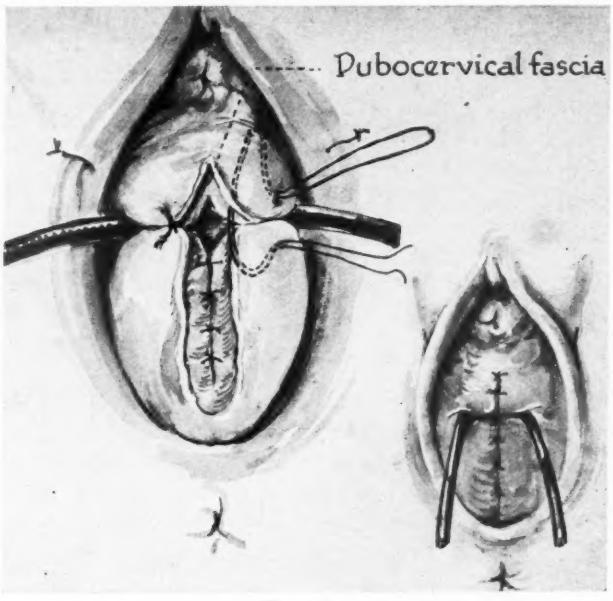

Fig. 6.

Two interrupted sutures are then placed. (Fig. 4.) These sutures pass successively through the mucous membrane of the anterior vaginal wall on the left side through the pubocervical fascia of the same side, the pubocervical fascia of the opposite side the mucous membrane of the opposite side, then through the mucous membrane of the posterior vaginal wall, the levator fascia of the right side, the levator fascia of the left side and the mucous membrane of the posterior vaginal wall on the left side. These sutures are then tied. In this manner, the pubocervical and levator fascia are approximated.

The levator ani muscles and fascia are then approximated by three or four interrupted sutures. (Fig. 5.) The levator muscle and fascia are then approximated to the ischio cavernosus (Fig. 6) muscle by a double suture passed successively through the mucous membrane of the posterior vaginal wall, the levator fascia and muscle, the ischio cavernosus muscle and the mucous membrane of the anterior vaginal wall. This is performed on both sides of the vagina. Three or four interrupted sutures are then used to approximate the vaginal mucosa in the midline. (Fig. 6.) The catheter is then withdrawn.

POSTOPERATIVE CARE

The patient is usually up in a rolling-chair on the third postoperative day. She is given a soft diet as soon as she desires food. Beginning on the third postoperative day, one ounce of mineral oil is given morning and night. No attempt is made to inhibit bowel function. As soon as the patient is allowed out of bed, she is placed in a hot Sitz bath twice daily, usually for a period of twenty minutes at a time for five to seven days. The duration of the bath is varied to suit the individual patient. The patient is allowed to walk on the fifth to seventh postoperative day. We believe that if elderly patients are allowed to be out of bed early, the chances of postoperative pulmonary complications are materially reduced. We have not noted any pulmonary complications in this series.

POSTOPERATIVE RESULTS

Perfect functional and anatomical results have been obtained in twenty-nine (93.5 per cent) of the thirty-one cases analyzed in this series. In one patient there was a

complete functional and anatomical failure. In another, an anatomical failure. In another, an anatomical failure of a marked degree, but fair symptomatic results. (The technic described by the authors was not used in these cases.) However, in one case, complete absorption of the suture material occurred in an exceptionally short time. We believe that factors that play a part in postoperative eviseration were present here. In neither of these patients were estrogenic suppositories given preoperatively.

CONCLUSION

1. The Le Fort operation has a definite place in the management of elderly women with complete prolapse of the uterus or of the vagina following hysterectomy.

2. Its advantages are permanent anatomical restitution and symptomatic relief, with a minimal surgical risk.

3. The operation is easily and rapidly performed under local anesthesia.

4. The patient can be placed in a chair early and the dangers of postoperative pulmonary complications markedly reduced in this manner.

5. The danger of recurrence is lessened if one utilizes the pubocervical and levator fasciae, rather than relying solely upon approximation of the vaginal mucous membrane flaps and submucous tissues.

6. In this series of thirty-one cases, excellent results were obtained in 93.5 per cent of the patients. There were no deaths.

Warning: From a recent letter received from Dr. Elmer J. Ball, who published an article entitled "A New Treatment of Ganglion" in our December, 1940 issue, we quote as follows:

"There have been two severe reactions reported to me and I am afraid that this treatment carries too severe a risk to be used widely. In these cases an excessive amount of solution was used, but, nevertheless, where such a reaction does occur, the risk is too great for such an innocent tumor. The treatment does have merit, but further work should be done before it is widely used."

EXTRA-ARTICULAR ARTHRODESIS OF THE KNEE JOINT*

DON KING, M.D., F.A.C.S.
Associate Professor of Surgery, Stanford University Medical School

AND

VICTOR RICHARDS, M.D.
Assistant Resident in Surgery, Stanford University Hospitals

SAN FRANCISCO, CALIFORNIA

OCCASIONALLY, in spite of the utmost care in selecting the time for operation, surgical invasion of a

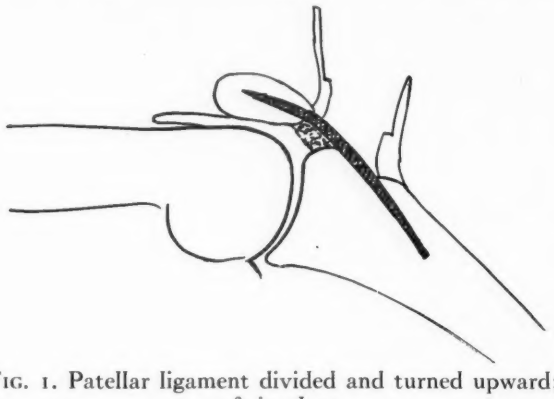

FIG. 1. Patellar ligament divided and turned upward; graft in place.

tuberculous knee is followed by direst consequences. Fistulae may follow the

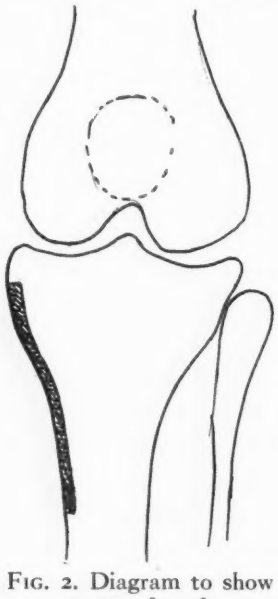

FIG. 2. Diagram to show source of graft.

operative procedure, secondary infection ensue, and amputation eventually become necessary.

The realization that fusion operations could not completely eradicate the tuberculous process, and that the most that could

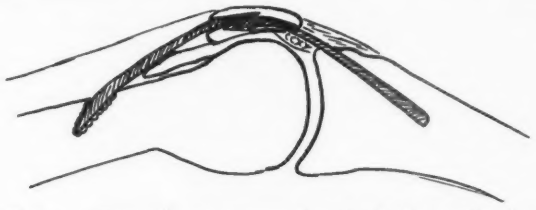

FIG. 3. Second state completed; both grafts in place.

be accomplished was its inactivation by preventing useless and dangerous motion, stimulated French orthopedists to develop an extra-articular method, as is done in the spine and hip.

In 1933, Delahaye[1] first recommended such a method for fusing tuberculous knees in children. He employed an extra-articular femoro-patello-tibial arthrodesis, using a long, supple graft taken from the opposite tibia.

Two years later (1935) Brandwayn,[2] a pupil of Delahaye, reviewed thirty-two cases (ages six to fourteen), in which the patients had been operated upon by this technic. None of these cases were more than two years postoperative. Pseudoarthroses and fractures of the grafts were frequent but were considered due to imperfection in technic. Two patients had developed secondary deformities, one a genu valgum and the other a genu recurvatum. The subsequent growth of the limbs had been symmetrical in all cases.

Calvet in 1937[3] reviewed seventeen cases of knee joint tuberculosis in children treated by extra-articular fusion. Here again the cases were only one to one and a

* From the Division of Orthopedics, Stanford University Hospitals and Stanford Surgical Service, San Francisco Hospital, San Francisco.

half years postoperative, but he also concluded that the graft grows at an equal rate with the limb. He reported two failures, one due to fracture of the graft, and the other to a pseudoarthrosis.

In 1939 Sorrel, Richard and Rouge[4] reported nine cases of tuberculous knees in children which had been fused in 1935 extra-articularly, and in which the results were unfavorable. In these cases the grafts had either fractured, had become detached from their insertions, or genu recurvatum had developed. They explained these undesirable results by stating that *the grafts do*

FIG. 4. Case I. A and B, preoperative *x*-rays; C, immediately following first stage; D and E, four years postoperatively.

not grow at an equal rate with the limb. Both Lance and Delahaye, in discussing this article, stated that in their experience genu recurvatum had occurred frequently, after a period of two to three years.

articular arthrodesis did seem rational for the adult knee, and had sufficient appeal to lead us in 1936 to develop a suitable operative technic.

For children Delahaye[5] recommended a

A B C D

FIG. 5. Case II. A and B, preoperative *x*-rays; C and D, four years postoperatively.

Extra-articular fusion for children has never appealed to us because the small size and cartilaginous character of the patella make it an unfavorable receptor for a graft. Furthermore, there is danger of growth arrest anteriorly from the graft crossing the epiphyseal lines.

On the other hand, the concept of extra-articular femoro-patello-tibial fusion. This technic cannot be used in adults because of the impossibility of securing such a long flexible graft. As possible sources of bone for the graft we considered rib and iliac

A B C D

Fig. 6. Case III. A, preoperatively; B, two years postoperatively; C and D, four years postoperatively.

A B

C D

FIG. 7. Case IV. A and B, preoperatively; C and D, four years postoperatively.

crest. Rib seemed unsuitable because of its weakness. Iliac crest could not be used because of its two-directional curve.

We decided to do the operation in two stages using short tibial grafts.

This paper briefly describes the operative technic and the present status of four patients so treated four years ago.

TECHNIC OF OPERATION

First Stage. The incision begins at the superior border of the patella, passes downward over the medial surface of the tibial condyle and proximal shaft of the tibia. The patellar ligament is divided in a double "L" manner (Fig. 1) and retracted from the field of operation. The periosteum and tendinous attachments are elevated from the medial surface of the upper tibia and a cortical graft about five inches long is cut from the curved surface of the medial tibial condyle. The upper end of the graft is about one and one-half inches wide and its lower end is about one inch wide. (Fig. 2.)

A small amount of infrapatellar fatty mass is now excised and the beds for the graft ends are made by inserting an osteotome into the inferior two-thirds of the patella and in the cancellous bone of the tibia just under the bursa lying beneath the patellar ligament. The wide end of the graft is now placed in the patella and the narrow end in the tibia. The graft is reenforced by multiple chips of bone. The patellar ligament closes snugly over the graft, serving to hold it in place.

A long leg cast is applied and left in place six weeks.

Second Stage. A tibial graft is first removed from the opposite tibia. It is important to remove it high on the condyle so that it will be curved and pliable. The old incision over the patella is now opened and extended directly upward a distance of eight inches. The rectus femoris tendon is exposed and incised along with the muscle fibers overlying the synovial pouch where it extends upward under the quadriceps muscle. By careful dissection one can expose the superior border of this pouch, and, in fact, by using a periosteal elevator, can displace it downward somewhat, so as to place the graft slightly farther distalward. A number of holes are now drilled through the cortex of the anterior surface of the femur just above the femoral condyle and the narrow end of the graft inserted. The wide flexible end is inserted into the superior border of the patella. The quadriceps muscle and tendon are closed firmly over the graft and a hip spica cast applied. (Fig. 3.)

After six weeks' time the spica is removed, an unpadded long leg cast is applied and the patient then becomes ambulatory. When the fusion is clinically and roentgenologically solid the patient is fitted with a long double upright brace.

CASE REPORTS

Case I. An American housewife, age twenty-two years, with no pulmonary tuberculosis, had a painful, swollen left knee for five years. The test was positive for tuberculosis (Guinea pig). The first stage of the operation was performed on January 25, 1936; the second stage on February 20, 1936. The leg was kept in plaster for six months, followed by a brace for six months. She has been walking unsupported, doing her own work for one year.

October, 1939. The patient uses her leg normally; solid ankylosis has occurred in complete extension. She had had two draining sinuses, one in scar anteriorly just above patella, and the other in the popliteal fossa, but they have been healed for six months. There is no pain or inflammation.

Case II. An irish housewife, age twenty-eight years, had been under observation at Stanford Chest Clinic since 1932 for pleurisy and pulmonary tuberculosis. She had a painful, swollen right knee for six months. The test was positive for tuberculosis (biopsy). A long leg cast for four months had been applied before operation. The first stage of the operation was performed on January 22, 1936; the second stage on March 1, 1936.

June, 1938. Plaster fixation totaled nine months. She developed a sinus anteriorly which was still draining, but the patient walked unsupported without pain.

October, 1939. The patient used leg normally. Solid ankylosis occurred in complete extension. Two sinuses anteriorly never healed. She can hop and jump without pain.

Case III. A colored girl, age seventeen years, with pulmonary tuberculosis, had pain and swelling in knee for nine months. The test was positive for tuberculosis (Guinea pig). The first stage of the operation was performed on March 23, 1936; the second stage on May 3, 1936.

June, 1938. Plaster fixation lasted nine months. She walked unsupported without pain and there were no sinuses.

October, 1939. The patient uses leg normally. Solid ankylosis took place in complete extension. There were no sinuses and no pain or inflammation.

Case IV. A Mexican bootblack, age thirty-seven years, had pain, stiffness, and swelling of the left knee for five years. The test was positive for tuberculosis (Guinea pig). The first stage of the operation was performed on January 30, 1936; the second stage on February 27, 1936.

June, 1938. Plaster fixation lasted for six months. A long double upright brace was used for six months. He returned to work in six months. There were no sinuses and no pain.

October, 1939. The patient used leg normally. Solid ankylosis occurred in complete extension. He jumped and hopped on leg without pain and there were no sinuses.

CONCLUSIONS

We have reviewed the pertinent literature on extra-articular arthrodesis of tuberculous knee. Most of this work has been done by French surgeons on children, using long, supple tibial grafts. These grafts may fracture, shorten the limb or produce a secondary recurvatum deformity.

Four years ago we experimented with an extra-articular two-stage technic on four adults with tuberculous knees.

At this time the knees are solidly ankylosed. There have been no fractures or pseudoarthroses of the grafts, which in fact, have hypertrophied to an astonishing degree. In only one, Case IV is there an osseous fusion across the joint. The disease process is quiescent in all cases, although one patient still has a draining sinus.

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HYPOPROTHROMBINEMIA IN INTESTINAL DISORDERS*

W. E. ABBOTT, M.D.
Resident Surgeon, University Hospitals

AND

W. D. HOLDEN, M.D.
Resident Surgeon, University Hospitals

CLEVELAND, OHIO

ACCORDING to the present concept of prothrombin formation, ingested vitamin K is absorbed from the intestinal tract in the presence of bile. On reaching the liver it in some way aids in the formation of prothrombin. A deficiency of prothrombin may result when the usual sequence of events is interrupted at any point. Hypoprothrombinemia, therefore, may result from any one or more of the following causes: (1) Absence of vitamin K. (Hemorrhagic disease of the newborn[1,2] and starvation.) (2) Absence of bile from the intestinal tract. (Obstructive jaundice[3] and complete biliary fistula.[4,5]) (3) Loss of bile from the intestines. (External and internal intestinal fistula,[6] repeated vomiting or intestinal intubation.) (4) Inadequate intestinal absorption. (Diarrhea and improper fat metabolism as seen in ulcerative colitis and nontropical sprue.[6]) (5) Decreased liver function. (Cirrhosis, leukemia, widespread carcinoma of the liver, hepatitis and anesthesia.[7])

In June, 1939, Clark, Dixon, Butt and Snell reported seven cases of hypoprothrombinemia due to various intestinal disorders.[6] During the past fifteen months we have seen seven somewhat similar cases.† Their series included one patient with nontropical sprue and one with bleeding ulcerative colitis. Quantitative prothrombin levels of 67 and 72 per cent, respectively, were found. In four similar cases which we have seen levels of 100 per cent of normal were present. We had one case of severe chronic ulcerative colitis with frequent hemorrhages in which repeated determinations (Quick's[8] method) were normal. However, we also believe that low levels could occur from faulty intestinal absorption but we think it would be rare in such cases for the blood prothrombin to fall to the bleeding zone (0 to 40 per cent of normal).

In practically all our patients whom we treated we have employed 2-methyl-1, 4-naphthoquinone and have used the iron salts of taurocholic and glycocholic acids when indicated.‡

Recently we saw three patients with peritonitis who had had practically no food for seven to twenty-eight days. The prothrombin level in these patients fell to 65, 70 and 75 per cent of normal, although each had received at least one transfusion of 500 cc. of citrated fresh blood. The blood prothrombin returned to normal in these patients when adequate food was given. In patients who are not receiving adequate diets and in whom intestinal intubation is being employed, we have noticed a more profound lowering of the blood prothrombin than in patients who have had only an inadequate diet.

Hypoprothrombinemia may occur in patients with a high ileostomy from a loss of either food products or bile, or a combination of the two. This opinion is also held by Clark, Dixon, Butt and Snell.[6]

Other workers have shown that inhalation anesthesia will produce temporary liver damage and even marked hepatic necrosis.[7] Changes in the prothrombin level found in such conditions are in all probability related to the duration of the anes-

† Since August, 1940, when this article was sent for publication, we have had five additional similar cases. Three patients developed hypoprothrombinemia while the intestinal tube was being employed, one because of a high external intestinal fistula and one other who had a prolonged inadequate diet. All responded to vitamin K therapy.

‡ Supplied by Eli Lilly and Co., Indianapolis, Indiana.

* From the Department of Surgery of University Hospitals of Cleveland.

thetic and the amount of liver dysfunction produced by it, or to the effects of the anesthetic superimposed on an already diseased liver. We also believe that a fall of the prothrombin blood level of more than 5 to 10 per cent must be attributed to something other than the usual gas-oxygen-ether anesthesia.

In the cases which we are presenting we feel justified, therefore, in assuming that the postoperative decrease in prothrombin levels which were found resulted only in a small part, if any, from anesthesia, but were produced largely because of the lack of vitamin K, loss of bile or a combination of the two.

REPORT OF CASES

Case I. This case is one in which the absence of vitamin K due to a prolonged inadequate diet probably caused hypoprothrombinemia.

A twenty year old, white man was admitted to University Hospitals of Cleveland because of pneumonia. Since the sputum showed type I pneumococci, sulfapyridine and type I antiserum were given. He responded quite well to this treatment, but after six days the temperature, which had subsided, again became elevated. An empyema was found and a rib resection with drainage of the empyema cavity was performed. On the third postoperative day signs and symptoms of peritonitis developed. Not long after this intestinal obstruction developed, and an abscess localized in the left lower quadrant of his abdomen.

On the thirty-second hospital day an abdominal abscess was incised and drained. Type I pneumococci were demonstrated in the pus. A Miller-Abbott intestinal tube was passed. The patient had been on a decidedly inadequate diet for a month and a half. Two days later his wound, which previously had appeared to be healing, began to ooze blood which failed to clot. The blood prothrombin level was 21 per cent of normal. Four mg. of 2-methyl-1, 4-naphthoquinone were given that afternoon and the dose was repeated that evening. The following two days he received 6 mg. of the same drug. All bleeding had ceased in twenty-four hours and his prothrombin level was found to be 82 per cent after forty-eight hours of treatment. Five hundred cc. of citrated fresh blood were given and a soft diet was started. It was believed that no further vitamin K therapy was necessary. Six days later the prothrombin blood level was 92 per cent. The patient continued to improve and was finally discharged from the hospital. At this time another prothrombin test was found to be 100 per cent of normal.

Case II. In this case the absence of vitamin K in the diet and the loss of bile through the intestinal tube led to hypoprothrombinemia.

A thirty year old negress was admitted with intestinal obstruction and an abscess in the right lower quadrant of the abdomen which had been present for five days. It was believed that the infectious process was due to salpingitis with a resulting pelvic abscess. Intestinal intubation was begun. The patient's fever which was high fluctuated widely, but the obstructive symptoms gradually disappeared. On the fourteenth hospital day she passed a large amount of blood per rectum and also blood was sucked back through the intestinal tube which had passed as far as the terminal ileum. A prothrombin level was 6 per cent of normal. Two mg. of 2-methyl-1, 4-naphthoquinone and 0.64 Gm. of bile salts were given orally for three doses at three hour intervals. Fourteen hours later bleeding had ceased and the patient's prothrombin time was 100 per cent of normal. The hemoglobin had fallen from 70 to 30 per cent. The patient was given no more vitamin K but received 200 cc. of citrated blood. Twenty-four hours later the level was still 100 per cent. In the next seven days two transfusions of 600 cc. of citrated fresh blood and one of 500 cc. were given. The prothrombin level over the next week gradually fell from 94 to 84 per cent. At this time the intestinal tube was removed and a high caloric, soft diet was begun. No further bleeding occurred and the hemoglobin gradually rose to 69 per cent. A posterior colpotomy was done several weeks later and pus was encountered. The temperature subsided following this and she was discharged improved.

Case III. Hypoprothrombinemia in this case was due to inadequate vitamin K intake and loss of bile due to prolonged gastric suction and a high external intestinal fistula.

A forty-two year old white man came to the hospital because of a perforated peptic ulcer. Plication of the ulcer under general anesthesia was done eighteen hours after the onset of the symptoms. Constant gastric suction was started postoperatively and the patient did fairly well until the wound disrupted on the seventh postoperative day. Secondary closure was carried

out. He received very little food except clear liquids for the next month and during most of the time was on gastric suction. Three weeks after admission an external intestinal fistula developed. About six weeks after admission a subdiaphragmatic abscess was drained, but the patient showed little improvement. Five days later blood was passed through the intestinal fistula and the edges of the wounds oozed blood. The prothrombin level was 20 per cent of normal. Attempts were made to give the patient vitamin K orally but it was repeatedly vomited. The patient ran a septic course and died two days later. Autopsy revealed multiple abscesses of the lungs, liver and kidneys, and a large amount of old and fresh blood throughout the entire intestinal tract.

Case IV. Hypoprothrombinemia in this case apparently resulted from both inadequate vitamin K intake and loss of bile due to a high intestinal fistula.

A fifty-nine year old white woman was admitted to the hospital with a preoperative diagnosis of annular carcinoma of the stomach. After preoperative preparation and two blood transfusions a subtotal gastrectomy was performed. Grossly the stomach appeared to be the seat of carcinoma. Although numerous microscopic sections were studied, no evidence of tumor could be found and the final pathological diagnosis was acute and chronic inflammation. A tube was put into the small intestines through the gastrojejunostomy at the time of operation with expectation of starting early feedings. The patient did poorly postoperatively and the wound disrupted. Shortly after this a high external intestinal fistula developed. On the eleventh and twelfth days after operation spontaneous bleeding from the wound occurred with slight evidence of clotting. The prothrombin content of the blood was 21 per cent of normal. Six mg. of 2-methyl-1, 4-naphthoquinone were inserted rectally but expelled; therefore, 4 mg. in intravenous saline were given. Fourteen hours later a catheter was inserted through the disrupted wound into a loop of jejunum and no bleeding was encountered. The prothrombin time was then 75 per cent of normal. Two mg. of 2-methyl-1, 4-naphthoquinone were given through the jejunostomy tube and this was repeated five hours later. One hour after the last dose the prothrombin level was 95 per cent of normal. During the next three days the patient received 2 mg. more of vitamin K and 500 cc. of blood. The prothrombin level at the end of this time was 100 per cent of normal. However, bronchopneumonia developed and diffuse fibropurulent peritonitis. The patient died two days later. Autopsy revealed no evidence of bleeding.

Case V. In the following case loss of bile because of intestinal intubation and external intestinal fistula, combined with occasional attacks of diarrhea and inadequate vitamin K intake, led to hypoprothrombinemia.

A thirty-two year old white female who was pregnant for nine months was admitted to the hospital because of appendicitis. Postoperatively, the patient was given sedatives in an attempt to prevent early termination of the pregnancy but without success. A term child was delivered on her second postoperative day. On the third postpartum day and fifth postoperative day, since signs of marked ileus were present, constant gastric suction was begun. The McBurney incision disrupted on the ninth postoperative day. After this an external intestinal fistula developed and occasional attacks of fairly severe diarrhea occurred. Intermittent gastric suction was employed. Six hundred cc. of citrated blood were given on the tenth, seventeenth and thirty-third postoperative days. The patient had shown no gross bleeding, but because of the possibility of hypoprothrombinemia a prothrombin test was performed. It was 33 per cent of normal. On her thirty-fourth postoperative day the level had risen to 40 per cent. Four mg. of 2-methyl-1, 4-naphthoquinone were given with 0.32 Gm. of bile salts. Twenty hours later the prothrombin blood level was 82 per cent of normal. One mg. of 2-methyl-1, 4-naphthoquinone was given every other day, and after four days the prothrombin level was found to be 76 per cent of normal. It was believed that the failure to respond after the last dose was probably due to the loss of bile by intermittent intestinal suction and through the intestinal fistula. The same dose of vitamin K with 0.32 Gm. of bile salts was given, and the intestinal suction was discontinued. The prothrombin level rapidly rose to 100 per cent of normal. She subsequently died from peritonitis.

Case VI. In this patient, prolonged vomiting led to a slight prothrombin deficiency.

A thirty-three year old white woman was admitted because of vomiting. She had apparently been quite well until eighteen years of age when these vomiting spells began. During the few years preceding admission the patient had experienced marked epigastric distress and fullness and had lost considerable weight. Her

stomach was greatly dilated, and there was marked retention. Roentgenograms showed marked pyloric stenosis. Because of the prolonged illness and inadequate absorption, a prothrombin blood level was determined and found to be 80 per cent of normal. It was believed that subtotal gastrectomy was advisable and because of the possibility of a prolonged postoperative course this patient was given 4 mg. of 2-methyl-1, 4-naphthoquinone and 0.64 Gm. of bile salts. The blood prothrombin rose to 94 per cent in twenty-four hours. One mg. of 2-methyl-1, 4-naphthoquinone and 0.32 Gm. of bile salts were given the following day, and twenty-four hours later a prothrombin blood level of 100 per cent was present. The patient subsequently had a gastrectomy performed and died on the third postoperative day from a beta streptococcus peritonitis. The prothrombin time fell only slightly postoperatively.

Case VII. In this patient a vitamin K deficiency resulted because of an inadequate diet.

A seventy-five year old woman was admitted to the hospital with a strangulated ventral hernia. Resection of two feet of the ileum was necessary because of a gangrenous loop of bowel. Postoperatively, she did very well, although she was on a very meager diet, until her seventeenth day when she passed the first of three bloody stools. A prothrombin time was 20 per cent of normal; therefore, 2 mg. of synthetic vitamin K were given four times in the next twenty-four hours. At the end of this time all bleeding had ceased and the prothrombin time had risen to 88 per cent of normal. Two mg. of 2-methyl-1, 4-naphthoquinone and 0.32 Gm. of bile salts were given twice in the next twenty-four hours and following this the prothrombin time was 100 per cent of normal. It remained there until her discharge from the hospital five days later, and no further bleeding occurred.

COMMENT

The cases presented show that in prolonged intestinal obstruction or dysfunction, hypoprothrombinemia does develop. Such cases, as well as those of obstructive jaundice, biliary fistulae or hemorrhagic disease of the newborn, have prothrombin levels of 100 per cent of normal or close to it after twelve to forty-eight hours of treatment (4 to 12 mg. of 2-methyl-1, 4-naphthoquinone, and bile salts given when indicated) provided that good liver function is present.

Recently we treated three patients with obstructive jaundice (two of whom were bleeding) who had prothrombin levels of 5 per cent, 10 per cent and 31 per cent of normal, respectively. Eight mg. of 2-methyl-1, 4-naphthoquinone and bile salts were given, and prothrombin blood levels of 100 per cent of normal were obtained in forty-eight hours or less.

We ran all tests by the method described by Quick,[8] and results were carefully checked and compared with normal blood daily. Recently the modification described by Stewart and Pohle,[9,10] has been employed, but we have found that these results change the percentage values very little, if at all.

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THE TREATMENT OF STAPHYLOCOCCIC INFECTIONS WITH THIAZOLE DERIVATIVES OF SULFANILAMIDE

C. ABBOTT BELING, M.D., F.A.C.S.
Associate Attending Surgeon, St. Barnabas Hospital; Assistant Surgeon, Newark City Hospital
NEWARK, NEW JERSEY

THIS paper consists of a report of the observations and conclusions made during the treatment of 130 cases of staphylococcic infections of various types during the past year with thiazole derivatives of sulfanilamide. Both 2 (para-amino-benzene-sulfonamido) thiazole and its methylated derivative, 2 (para-amino-benzene-sulfonamido) 4-methyl thiazole, or sulfathiazole and sulfamethylthiazole,* were used.

While three-fourths of the cases were seen in two hospitals, the entire series is made up of patients treated in fourteen hospitals, many in conjunction with their own attending physicians. As some of these may be reported individually in detail by their own physicians at some later date, no attempt has been made to present them here in such a manner. The cases of furuncles of the face, carbuncles and abscesses reported previously by Beling and Abel[1] are included in this series.

The investigation was originally undertaken to determine the effect of the thiazoles on acute staphylococcic infections that are usually fatal, with the hope that some significant reduction of mortality could be obtained. The results of the writer and other investigators with staphylococcic antitoxin and with specific bacteriophage during the past five years have left much to be desired. A plan of clinical research was evolved and put into effect in various hospitals in Essex County, New Jersey. During the first five months the drugs were given only to patients with staphylococcic bacteremia, acute osteomyelitis, acute staphylococcic cellulitis, furuncles and carbuncles of the face, carbuncles with generalized systemic reaction, acute infections in diabetics, and acute infections of the urinary tract. Later, the use of the drugs was extended to less severe infections caused by the staphylococcus, including ambulatory patients. A special treatment data sheet was attached to the chart of each patient for the recording of the following information: The amount of each dose, the time and route of administration with corresponding temperature, pulse and respiration; daily determination of the level of free drug in the blood in milligrams per cent; results of daily blood counts, urinalyses, blood and wound cultures; additional therapy, and remarks regarding reactions, improvement of condition and any other information pertaining to the progress of the case. An instruction sheet was supplied to each ward, private pavilion, intern and resident with full directions for administration of the drugs in various forms, the minimum requirements for laboratory work, warmings regarding other medications and the possibility of the development of reactions with instructions for their detection. Thus a close check was kept upon the use of the drugs and all reactions carefully watched.

The results in the first thirty patients treated with sulfamethylthiazole indicated that it was a relatively safe drug to administer, and its use was extended to less severe staphylococcic infections. This drug was withdrawn from use, however, because of the several cases of lower motor neurone involvement or so-called peripheral neuritis that had been observed by a few investiga-

*The sulfathiazole and sulfamethylthiazole were supplied by the Department of Medical Research of the Winthrop Chemical Company and the Maltbie Chemical Company.

tors. Sulfathiazole was substituted and was used in all subsequent cases. Since no lower motor neurone effect had been reported in patients receiving this drug, it was considered justifiable to employ it for ambulatory patients. Fifty-two patients received sulfamethylthiazole and seventy-eight took sulfathiazole.

All determinations of the free and total drug in the blood, urine and feces were done according to the method of Bratton and Marshall,[2] utilizing N (1-naphthyl) ethylene diamine dihydrochloride as the coupling dye. Many of the determinations were done with the use of alcohol as the extracting agent. More recently trichloracetic acid has been used for extraction.[6] It seems to produce a more definite color and lends itself to more accurate determinations. The standards for the latter tend to fade more rapidly, however.

TYPES OF CASES

Staphylococci were identified either from the wounds or the blood stream in all cases. Seventeen cases exhibited mixed infection with both streptococci and staphylococci, and in one instance Bacillus pyocyaneus was present. Tables I and II illustrate the types of organisms encountered and the various conditions treated.

TABLE I
TYPES OF ORGANISMS

Organism	Cases	Sulfathiazole	Sulfamethylthiazole
Staphylococcus:			
Aureus	73	41	32
Albus	34	22	12
Unclassified	23	11	12
Streptococcus	17	8	9
Bacillus pyocyaneus	1	1	0

ADMINISTRATION AND DOSAGE

Oral. Both sulfathiazole and sulfamethylthiazole were used in this series. The earlier patients received sulfamethylthiazole in powdered form, made up into ½ Gm. capsules which were later supplanted by ½ Gm. tablets. Sulfathiazole was used in tablet form only. The tablets were given by mouth and swallowed whole with a little water or were powdered and suspended in milk. The first few adults of 150 pounds or more were given an initial dose of 3 Gm. followed by 2 Gm. every four hours day and night. Extremely severe cases, such as patients with septicemia, were given as much as 5 Gm. initially, children taking 1 Gm. per twenty-five pounds. These doses were found to be unnecessary in the average case and it became routine to give an initial dose of 2 Gm. and maintenance doses of 1 Gm. every four hours to adults. Children received an initial dose of 0.5 Gm. per twenty-five pounds of body weight and maintenance doses of 0.25 Gm. per twenty-five pounds every four hours, calculated to the nearest ½ Gm. It was often necessary to exceed this dose with children in order to reach and maintain a reasonable level of free drug in the blood.

TABLE II
CONDITIONS TREATED

Condition	No. Cases	Sulfathiazole	Sulfamethylthiazole
Septicemia	11	6	5
Bacteremia	3	2	1
Abscess	22	12	10
Furuncle—face	12	8	4
Body	8	7	1
Carbuncles—face	5	1	4
Neck and body	14	12	2
Cellulitis	19	11	8
Infected wound	23	9	14
Cystitis and pyelitis	10	7	3
Pneumonia (staph.)	11	7	4
Empyema (staph.)	5	3	2
Thyroiditis	1	0	1
Breast abscess	1	0	1
Chronic osteomyelitis	7	2	5
Acute osteomyelitis—long bones	5	4	1
Fingers and toes	5	3	2
Pyodermia	3	0	3
Peritonitis	1	0	1
Diabetes	6	2	4

In fact, all maintenance doses should be recalculated after the first blood level of free drug has been taken, eighteen to twenty-four hours after commencing treatment, and should be adjusted to maintain the level desired. Occasionally adults may require large doses. When it was not advisable to give the drug by mouth, it was introduced through a tube into the upper duodenum.

Intravenous. Whenever it was desirable or necessary to obtain an immediate elevated blood level of free drug the sodium salts, sodium sulfathiazole and sodium sulfamethylthiazole, were utilized. The sodium sulfamethylthiazole was prepared in the laboratory by treating sulfamethylthiazole with sodium hydroxide in equal molecular proportions, as follows: 0.8 Gm. of sodium hydroxide dissolved in 54 cc. of distilled water were titrated into a flask containing 5.38 Gm. of sulfamethylthiazole. After solution had taken place, the contents of the flask were filtered and the pH adjusted to 10.4 or just above, never over 10.5. The solution was then sterilized by boiling and placed in sterile rubber capped vials for parenteral use. A slightly yellow color usually developed and numerous crystals came down onto the bottom of the vials. The resulting solution was about 10 per cent. Sodium sulfathiazole was obtained in white powdered form directly from the manufacturers, thus eliminating a repetition of the above process. It was supplied in ampoules containing 1 Gm. After opening an ampoule, the powder was mixed with 20 cc. of sterile distilled water and thoroughly agitated in a 20 cc. syringe to facilitate solution. Injection into the patient was then performed. From 2 to 3 Gm. of sodium salt were used for the average adult of 150 pounds or 75 Kg. and corresponding amounts for children. In either case, a limit of 75 mg. per Kg. of body weight or 300 mg. per ten pounds was not exceeded. Such intravenous injections must be given slowly, preferably over five to fifteen minutes. One-half the initial dose can then be given every four hours, if necessary. Whenever possible it is best to supplement intravenous injection by oral medication. Rapid and repeated intravenous administration of strongly alkaline solutions may cause troublesome thrombosis and even laking of red blood cells. The sodium salts were not used in this study unless it was impossible to give the drug in the regular way. Few patients, therefore, received intravenous injections. It is my conclusion that the frequent use of these compounds intravenously is not justified because of their potential danger to the local blood vessels and to the kidneys. Large numbers of crystals are invariably seen in the urine after injection of the sodium salts into the blood stream.

Rectal. Both sulfamethylthiazole and sulfathiazole were given by rectum in a few cases because of the inability of some patients to tolerate them by mouth. The drugs were powdered and suspended in water or saline solution before instillation into the rectum. The technic is simple and similar to rectal use of sulfapyridine and sulfanilamide. It was not satisfactory from the standpoint of absorption.

Local. After receiving assurance that the process of manufacture of the thiazoles was such that the presence of spores of organisms in the finished product was extremely unlikely, it was decided to try the drugs locally in wounds. During January, 1940, sulfamethylthiazole was utilized in this manner, employing a saturated solution of the powder in sterile normal physiological saline solution or in distilled water. For practical purposes, the aqueous solubility of sulfamethylthiazole was considered to be 200 mg. per liter at 28°C. If the water was warmed to body temperature or higher, about 230 mg. went into solution. This 20 mg. per cent solution was used for open, infected wounds and was prepared in the hospital by adding the appropriate amount of powdered drug to a flask of warm, sterile, physiological saline solution and warming to body temperature. Sulfathiazole was employed in the same manner, except that its relatively increased

solubility resulted in a 60 mg. per cent solution with the addition of the proper amount of powder. On cooling, crystals came down out of each of these solutions. No attempt was made to filter out the crystals and they were allowed to go into the wound. The application of this method of treatment will depend upon each individual wound. Although one will do better with irrigation at frequent intervals with a syringe, others may respond more readily to a continuous drip delivered into the depths of the wound through perforated tubes in the manner of Dakinization. The latter seems to be advisable in extensive compound fractures with macerated tissue and loss of substance. The usual sterile precautions must not be omitted. I have also introduced the powdered drug directly into surgical wounds and into the peritoneal cavity, but the results do not lie within the scope of this paper. Powder or crystals are probably superior when one wishes to débride and close a wound tight without drainage.

ABSORPTION AND EXCRETION

The absorption of the thiazoles from the human gastrointestinal tract varies widely in certain individuals, although it is fairly constant on the whole. It may even vary in the same individual from day to day. We must assume that, since absorption takes place from the intestinal tract, there are a number of factors such as the rapidity of the passage of material through the tract and the condition of the mucous membranes of the various portions with regard to their power of absorption at any given time. It is impossible, therefore, to draw any comparative conclusions regarding the amount and rate of absorption of the drugs in humans, except to show some parallelism in the behavior of large groups of individuals.

The thiazoles are excreted much more rapidly than sulfanilamide or sulfapyridine, and this has an important bearing on the time interval between doses. The drugs should be given every four hours in order to maintain an adequate blood level. This was sometimes difficult in children because of extremely rapid excretion. Absorption from the gastrointestinal tract was less even than with sulfanilamide and more even than with sulfapyridine. On the average it was satisfactory. Variations in absorption were demonstrated in the same individual by daily fluctuations of from 1 to 2 mg. per cent on regularly maintained and spaced dosage. In the earlier patients who received sulfamethylthiazole it was noted that the average adult exhibited a blood level around 7.0 mg. per cent of free drug after receiving from 20 to 25 Gm. by mouth during the first forty-eight hours prior to the determination. Analysis of later cases revealed that an initial dose of 2 Gm. followed by 1 Gm. every four hours usually resulted in a blood level of free drug in adults of about 4.0 mg. per cent and almost always in a level about 2.9 mg. per cent. Absorption apparently continued with larger doses and blood levels of free drug exceeding 20 mg. per cent were obtained. The maintenance of a steady blood level in children could not be predicted by rule and was achieved by trial in each individual case, always keeping in mind that excretion is extremely rapid and that in some children doses of 2 Gm. every four hours may be necessary to reach and maintain a level of 4.0 to 6.0 mg. per cent.

The thiazoles were not absorbed readily from the rectum, even under the most advantageous conditions. Although no attempt was made to determine the optimum percentage concentration for absorption, it is reasonable to assume that such must exist. The established behavior of glucose solutions in the rectum gives us the basis for this assumption. At best, one cannot hope for adequate blood levels from rectal administration of the thiazoles.

As far as has been determined, the use of saturated solutions locally in open wounds does not result in a sufficiently high level of drug in the blood stream to be detected by tests routinely employed.

After the thiazoles enter the blood stream they exist there in the free form and

would be excreted as such if not for the fact that acetylation or conjugation takes place, probably in the liver. Sometimes the longer the drug remains in the blood stream the more of it becomes conjugated. This has been demonstrated with single doses administered to patients with impaired renal function. They acetylated as much as from 50 to 70 per cent of the drug. The average adult in this study acetylated approximately 29 per cent, calculated from all the determinations of free and total drug made. Children, owing to very rapid excretion, sometimes acetylated very little of the drug. Under normal conditions, therefore, the amount of sulfathiazole or sulfamethylthiazole conjugated is low in comparison to the free form. The proportion of acetylated drug is relatively high in the urine and very low in the stools. The experience of other investigators in this direction is closely parallel.

The blood stream is entirely cleared of the thiazoles, as far as can be detected by routine tests, in twenty-four to forty-eight hours depending upon the amount of drug in the circulation at the time medication is discontinued, other things being normal. Excretion takes place mainly through the kidneys and slightly through the gastrointestinal tract, so that both forms are recovered from the urine and feces. Crystals of both may appear in the urine.

TOLERATION AND REACTIONS

Because of the relationship of sulfathiazole and sulfamethylthiazole to sulfanilamide and its various other derivatives, it was logical to assume that the thiazoles might produce reactions similar to those already observed when the other compounds were administered. All patients were carefully watched, therefore, for the development of such reactions as nausea and vomiting, anemia, leukopenia, agranulocytosis, hyperpyrexia, skin rashes, hematuria, urinary disturbances including anuria and lithiasis, cyanosis, psychic disturbances, neuritis and other phenomena. The various toxic manifestations that occurred in this series are listed in Table III. Sulfathiazole caused less side effects of serious nature and was better tolerated than sulfamethylthiazole. One patient receiving sulfamethylthiazole developed a mild lower motor neurone involvement. Two patients taking sulfamethylthiazole experienced diplopia on the tenth and twelfth days, respectively. In both instances it disappeared within forty-eight hours after discontinuing the drug, reappeared when medication was resumed and promptly disappeared the second time after permanent withdrawal. There were no residual signs or symptoms. Neither patient took a large amount of the drug at any one dose but took it over a period of from four to six weeks, with blood levels around 4.0 mg. per cent of free drug. Five patients exhibited cyanosis from sulfamethylthiazole and in each case the intensity of the cyanosis was more or less dependent upon the blood

Table III
TOXIC MANIFESTATIONS

Reactions	Sulfathiazole		Sulfamethylthiazole		Both Drugs	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Nausea	21	26.95	17	32.70	38	29.20
Vomiting	8	10.25	11	21.18	17	13.19
Headache	8	10.25	7	13.46	15	11.54
Dizziness	6	7.68	1	1.93	7	5.38
Weakness of extremities	3	3.84	1	1.93	4	3.68
Muscular pains	0	0.00	0	0.00	0	0.00
Neuritis	0	0.00	1	1.93	1	0.77
Hyperpyrexia	2	2.56	1	1.93	1	0.77
Skin rash	4	5.12	4	7.69	8	6.16
Diarrhea	1	1.28	0	0.00	1	0.77
Hematuria	2	2.56	3	5.48	5	3.84
Pyuria	0	0.00	1	1.93	1	0.77
Crystalluria	10	12.82	20	38.50	30	23.08
Renal calculi	0	0.00	0	0.00	0	0.00
Anemia	0	0.00	2	3.85	2	1.54
Leukopenia	0	0.00	0	0.00	0	0.00
Cyanosis	0	0.00	5	9.62	5	3.84
Psychic disturbance	0	0.00	0	0.00	0	0.00
Diplopia	0	0.00	2	3.85	2	1.54
Conjunctivitis	2	2.56	0	0.00	2	1.54

level. After the level was adjusted to lower figures, around 4 to 5 mg. per cent, the cyanosis became scarcely noticeable. It was

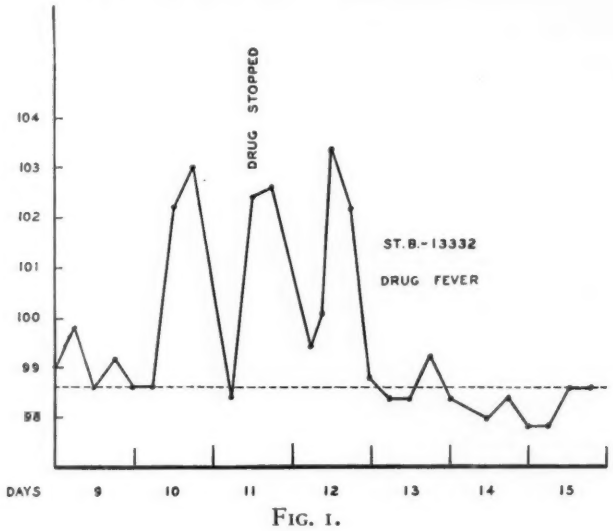

FIG. 1.

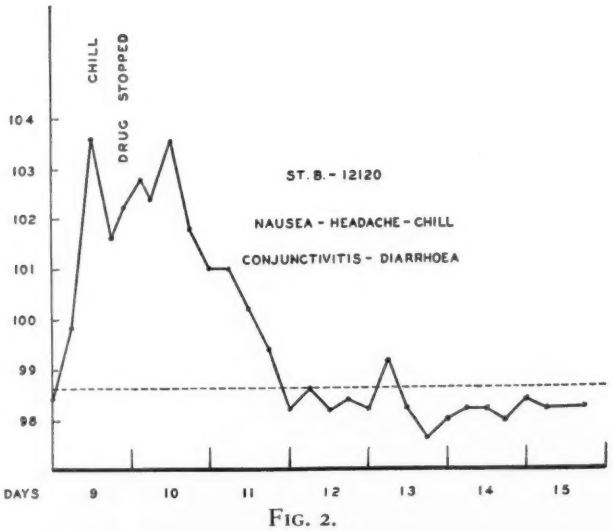

FIG. 2.

quite evident when the blood level was around 7 to 9 mg. per cent. None of these side effects occurred with sulfathiazole.

The presence of several types of reactions in the same case is not uncommon. Some of the reactions may present a problem in management, such as the determination of the cause of a fever. Is the fever due to a drug reaction or to the disease itself? Since the majority of drug fevers occur around the sixth to ninth days, since there are few lesions due to the staphylococcus which are not fairly well under control with reduction of temperature by that time, and since the spread of infection in the presence of an adequate blood level of sulfathiazole is most unlikely, not having occurred once in this series, we must assume that any unusual temperature reaction between the fifth and tenth day is probably due to the drug. If our assumption is correct, and it will usually be so, the fever will promptly be reduced with the disappearance of the drug from the blood stream during the ensuing twenty-four to forty-eight hours. (Fig. 1.) Hyperpyrexia from the thiazoles may manifest itself as a steady elevation of temperature, as a more or less gradual or abrupt rise, or as a septic type of fever with wide spikes (Fig. 2) and occasionally with chills. (Fig. 1.) Skin rashes are said to be

rather common but were noted in but seven cases of the combined series and only three times with sulfathiazole. They took the form of either papular erythematous or scarlatiniform eruptions except that one patient had lesions similar to erythema nodosum. In no instance did the rash progress in severity when the drug was continued. In this connection it is important to note that the thiazoles differ from sulfanilamide in their reaction to various rays. Photosensitization apparently did not occur and it was possible to combine roentgen and sulfathiazole therapy without any of the sensitizing effect reported with sulfanilamide.[5] Furthermore, sulfathiazole may be given to persons who are up and about in the sunlight without any evidence of photosensitization. Likewise, ultraviolet light is not contraindicated during the course of treatment.

Injection of the sclerae and conjunctivae similar to acute conjunctivitis or common "pink-eye" was experienced by three of the patients taking sulfathiazole and it occurred on the seventh, ninth and twenty-fourth days. One patient had a combination of conjunctival and scleral injection, an erythema nodosum type of rash, headache and general malaise. These were severe but disappeared within forty-eight hours after discontinuing medication. She received about 3 Gm. daily for several weeks before the reactions set in. Two months later, after having resumed medication for several days and having taken about 20 Gm., the same reactions reappeared. This time the drug was not stopped. After four days the conjunctival and scleral reactions cleared entirely. The erythematous nodules continued but also disappeared after one week. The drug was continued at the rate of 3 Gm. daily and no further reactions developed until two weeks later when she again experienced slight scleral and conjunctival reaction for three days associated with a tired feeling. The urine was normal at all times and no further reactions developed. Hematuria was noticed in four patients, three of whom received sulfamethylthiazole. In all but two instances the hematuria was microscopic. The urine of one patient had a slightly red tinge when the drug was discontinued. The hematuria appeared in these cases at any time between the second to the forty-second day. Crystals of free and conjugated drug were commonly seen in the urine. Sulfamethylthiazole crystals were especially abundant and were frequently mistaken for urates. Sulfathiazole crystals were often reported as leucine and tyrosine. Occasionally there was a temporary diminution of urinary output. One patient had a severe staphylococcic septicemia and exhibited gross hematuria with great reduction of urinary output bordering on anuria. Sulfathiazole was discontinued immediately and the output and urine became normal in three days. The problem then was whether to allow him to die from the septicemia or to continue giving the drug and take a chance on the kidneys failing. The latter was decided upon and, surprisingly enough, he had no further reactions and recovered nicely from the septicemia.

Nausea is a frequent feature of thiazole therapy, being experienced by 26.95 per cent of the patients who took sulfathiazole and 32.70 per cent of those who took sulfamethylthiazole. Vomiting was several times more frequent with the latter. Headache sometimes accompanied the nausea but was more liable to be present if there was vomiting. There were two ambulatory patients who merit special attention. Both took sulfathiazole by mouth in the usual quantities. While their infections were acute they experienced no reactions other than a slight loss of appetite. After twelve days and 52 Gm., and eleven days and 49 Gm., respectively, they presented almost identical symptoms including severe headache, nausea, dizziness, sweating, extreme weakness most noticeable in the lower extremities, and occasional vomiting. The second man also had a shaking chill lasting about fifteen minutes. In both cases the symptoms disappeared entirely within forty-eight hours after discontinuing the

drug. When medication was resumed one week later in the first case, the symptoms returned after ingestion of 4 Gm. and were severe. They again disappeared completely within forty-eight hours after stopping the drug. There were no residual signs or symptoms one week later.

Particular mention must be made of the absence of acute anemia, leukopenia or agranulocytosis in the sulfathiazole series. A gradual reduction of red cells was observed in one case of staphylococcic pneumonia. The erythrocyte count was 3,380,000 and the hemoglobin was 72 per cent when thiazole therapy was commenced and at the end of the fourteenth day the hemoglobin was 60 per cent and the erythrocytes numbered 3,080,000. A transfusion of 500 cc. of whole blood was given. A young white male with a large carbuncle of the buttock, showed a decrease of his leukocyte count from 19,000 to 5,000 in four days, but it came up to 6,600 while the drug was being given. One gradual anemia was encountered with sulfamethylthiazole. Another patient received sodium sulfamethylthiazole by vein and suffered a rapid laking of blood probably due to the extreme alkalinity of the solution and somewhat to the speed of the injection. Her erythrocyte count was reduced by 1,000,000 cells and her hemoglobin by 21 per cent within thirty-six hours. Transfusion restored it and there was apparently no depressant effect of the drug on the hematopoietic system.

The appearance of reactions to the thiazoles does not seem to have any direct relationship to the amount of drug given, and sometimes the most severe reactions were seen with smaller aggregate amounts. The patients in this series received total doses of from 4 Gm. of sulfamethylthiazole and 8 Gm. of sulfathiazole to 244 Gm. of sulfamethylthiazole and 295.5 Gm. of sulfathiazole over periods varying from two days to sixty-six days with sulfathiazole and to seventy-five days with sulfamethylthiazole. The majority of those patients who took the drugs for longer periods did not have troublesome reactions. The management of patients after reactions have appeared is extremely important and therein often lies success or failure. Should we discontinue thiazole medication when reactions develop? The answer is best given from the combined experience of the various investigators and not from some unsubstantiated idea which may happen to exist in any individual's mind. My own observations are that withdrawal of the drug is not indicated in the presence of nausea, occasional vomiting, headache, crystalluria, skin rashes and conjunctival reactions except under unusual circumstances. These side effects tend to pass off within twenty-four to seventy-two hours. Occasionally vomiting may be persistent or a skin eruption may be especially severe so that medication must be stopped. Whenever there is an adequate urinary output, over 1,000 cc. daily, the appearance of large numbers of crystals in the urine should not require modification of dosage. When the output is low, efforts should be made to improve this rather than to withdraw the drug. Moderate anemia has not been considered an indication for withdrawal and in at least one case therapy was continued with small transfusions as adjuncts. Microscopic hematuria was also noted but the drug was not taken away unless the urine was slightly tinged with red or there seemed to be increasingly larger numbers of red cells per high power field on microscopic examination. Absolute indications for cessation of thiazole therapy, unless modified by further clinical evaluation, are the appearance of gross hematuria, hyperpyrexia, conjunctivitis of severe nature, neuritic symptoms and signs, chills, severe psychic disturbance, and also agranulocytosis, leukopenia and acute anemia if they should occur. The last three were not encountered in this series. Whenever such reactions do occur, the drug should be withdrawn immediately and fluids administered in large quantities to promote excretion. It is also advisable to administer a rapid acting cathartic to eliminate any unab-

sorbed and whatever excreted drug exists in the gastrointestinal tract. All these reactions will, as far as my observations indicate, respond to this simple régime.

EVALUATION OF TREATMENT

Of the entire series of 130 staphylococcic infections treated with the thiazoles, 116 were improved, five were not improved and nine patients died. The criterion for improvement was that the lesion being treated must resolve and disappear within a reasonable time, the length of which depends upon the type of lesion. As four patients died from infection by other organisms after the staphylococcic infection had been successfully eliminated, this number should rightly be added to the list of improved, making a total of 120, or 92.3 per cent. The remaining deaths were due strictly to staphylococcic disease or staphylococcic septicemia. All but one were not seen until very late in the course of the disease and from three to twelve hours before death. The presence of extensive metastatic lesions precluded the hope of recovery. They must be included, however, in order to make any valid comparison with the gross uncorrected mortality in staphylococcic septicemia both untreated and treated by other means. One patient with a local cellulitis died after several days treatment. He had pneumonia, nephritis and a long history of chronic and recent acute alcoholism prior to admission. His cellulitis was not the cause of death. One of the patients not improved was a sixty-two year old black female, diabetic with honeycombed abscesses throughout the scalp and subaponeurotic region, preceded by cellulitis following an injury to the scalp. Staphylococci were repeatedly cultured from the pus. Roentgen therapy also failed to have any appreciable effect. The other four patients who failed to respond to the thiazoles either had chronic osteomyelitis with sequestra or had various conditions other than staphylococcic infection which accounted for the main clinical picture.

Recurrences were unusual except in the presence of mechanical factors in urinary tract infections, such as renal calculi. This statement applies only to those patients who have been adequately treated from the standpoint of dosage and time. It is easy to obtain recurrences if the dosage is too low or the drug has been withdrawn too soon. This is particularly liable to happen in staphylococcic pneumonia and staphylococcic septicemia. The earlier cases in the series were tapered off toward the end by reducing the dosage gradually to complete withdrawal over several days to a week. Because it was concluded that the very low blood levels of the drugs during the last days of treatment were not sufficient for any appreciable effect, this method was abandoned and it is now my practice to continue treatment up to the time of withdrawal so as to maintain a more or less constant blood level of free drug, and then to stop the dosage abruptly. The free drug in the blood stream diminishes rapidly according to the individual rate of excretion. Pyodermias, carbuncles, infected wounds, cellulitis and abscesses were treated until the lesion had resolved or disappeared. Febrile conditions such as staphylococcic peritonitis, endometritis or pneumonia were treated until the temperature, pulse and respirations had been normal for at least one week. Later in the series this time was reduced to four days. It is absolutely essential that all acute osteomyelitis and other forms of staphylococcic septicemia be treated for longer periods in order to prevent recurrences which are almost inevitable with small doses and inadequate treatment time. In my opinion these cases should receive full doses, with a maintained free drug blood level of from 6 to 9 mg. per cent, until all blood cultures are negative, until collections of pus that can be reached have been drained surgically and have healed, and until the temperature, pulse and respirations have been normal for at least two weeks. Treatment should be resumed at the slightest indication of a relapse. This means that patients with acute osteomyelitis, for example, may re-

ceive the drug for many weeks. Urinary infections which are not complicated by mechanical factors such as calculi and certain abnormalities of the genitourinary tract may be handled much in the same manner as carbuncles and febrile conditions. When these other factors are present, however, the problem is a difficult one and the percentage of recurrences must be high. The first course of the drug should be continued for several weeks after subsidence of all symptoms and therapy should be immediately reinstituted when any symptoms return. One of the patients so treated had the complicating factor of a kidney stone. After the first three series of treatments with sulfathiazole he remained symptom free without any abnormal urinary findings for about one month each time. With each successive period of treatment the free interval became shorter so that his hematuria, pyuria, burning and frequency returned within one week. Considerably smaller doses of the thiazoles are sufficient to control staphylococcic urinary infections. Even though the blood level of free drug is 2 mg. per cent or lower, the concentration in the urine is high. For example, if a patient receives as little as 1 Gm. daily and half of this amount is excreted into the urine and the urinary output is 2,000 cc. daily, there will be 0.5 Gm. in 2,000 cc. or a 25 mg. per cent solution. This concentration has been shown to have the effect of reducing the growth of Staphylococcus aureus in the urine.[4] When other organisms are present, and for complete elimination of the staphylococcus, concentrations of 50 mg. per cent or higher are necessary. The results with chronic osteomyelitis would be very disappointing if the mechanical factors were not taken into consideration. The poor response of certain cases can probably be attributed to this factor. As long as sequestra are present discharge will continue to flow from the sinuses. The use of sulfathiazole before and following operative removal of such sequestra is, of course, logical and indicated.

Neither the thiazoles nor any other drug can perform the duties of the scalpel. This point cannot be too frequently or strongly emphasized. Collections of pus must be evacuated and the indications for surgical drainage are certainly not altered by the fact that a drug is being given. The use of sulfathiazole preoperatively in adequate amounts, however, is advised for its effect in preventing the spread of infection locally and the development of generalized hematogenous infection. If prompt operation is necessary, the intravenous administration of sodium sulfathiazole will create a proper blood level quickly. As long as there is an abscess under tension, thiazole medication will not cause a drop of the temperature until evacuation has been accomplished. Rapid subsidence follows. Small abscesses may sometimes absorb. This advice does not apply to furuncles or carbuncles. These will evacuate spontaneously and readily when the thiazoles are supplemented with warm wet dressings. Occasionally, a carbuncle may require a minimum amount of surgery well within the limits of the infected area. The behavior of furuncles, carbuncles and abscesses under thiazole therapy has been set forth more fully in a previous communication.[1]

The length of time required for any given staphylococcic lesion to respond depends upon its type and the stage of its development. Too often I have heard the careless statement that if sulfathiazole does not do its work in three days, it will not be of any use. Such statements are misleading, ill advised and inaccurate. In fact, one hears many curious statements regarding the sulfonamide derivatives which have little to substantiate them but which seem to stick in the minds of both the practitioner and the public. Furuncles and carbuncles will show definite changes within three days, often progressing to complete resolution. Certain cases of cellulitis, on the other hand, require up to eight days and occasionally longer. No reasonable person should expect miraculous cures of staphylococcic pneumonia, acute osteomyelitis and staphylococcic septicemia within two or three days.

The most dramatic and satisfying results in this series were seen in cases with staphylococcic septicemia and with infections of the dangerous area of the face. The reduction of mortality to 27 per cent in the former group is tremendously significant when compared with the results from staphylococcus antitoxin and specific bacteriophage. This will be reported at length at a later date. There were twenty-six cases of facial infections. They all recovered although some of the patients had particularly grave and extensive infections. One girl had cellulitis of the nose, face and eyelids, an abscess of the nose, thrombophlebitis of the angular and ophthalmic veins and orbital cellulitis. An elderly white male, diabetic, had a similar process, with a carbuncle of the eyelids, nose and forehead. A young male had another similar process about the face and eye with involvement of the angular vein and proven bacteremia. They all recovered rapidly. The mortality in such untreated advanced cases and the incidence of cavernous sinus involvement is not small, particularly after trauma, which was a factor in each of the cases cited. The behavior of acute staphylococcic osteomyelitis is very interesting. To date five patients have been treated from the inception of the disease. All have recovered. Each had a soft tissue abscess incised and drained and the bone or periosteum were not disturbed. Each abscess healed up completely. There are now no draining sinuses and there has been replacement of bone in each patient. Although the longest follow-up period is six months after discharge from the hospital and the patient has shown no recurrence or residual disability, sufficient time has not elapsed to allow any conclusions as to the eventual results. Immobilization of the affected part was employed in each case in addition to thiazole therapy.

It has been suggested that roentgen therapy is contraindicated when thiazoles are being given. This has probably been prompted by the reports of photosensitization following exposure of patients receiving sulfanilamide to roentgen rays, ultraviolet lamps and strong sunlight.[5] There is no basis in fact for this assumption. No evidence of photosensitization was noted in the cases that were exposed to the effects of both types of agents. Furthermore, other reports to the contrary,[3] the combination of thiazoles and roentgen rays did not appear to influence the course or outcome appreciably so that it cannot be said from this experience that there is any antagonism or synergism between the two agents. There would not seem to be any virtue, therefore, to the addition of roentgen therapy to the management of these cases. This is not to be construed as criticism of the roentgen ray, which may produce satisfying results by itself.

Both sulfamethylthiazole and sulfathiazole were used locally in solution or in powdered form. In one instance the powder was made up with petrolatum to make an ointment. The results of the use of powder are not embodied in this report. Treatment was confined to extensive open infected wounds. One patient had a compound fracture of the leg involving both bones with associated maceration and considerable loss of substance. He received the solution through Dakin tubes inserted into the depths of the wound. Aerobic streptococci and staphylococci were effectively inhibited but anaerobic streptococci were frequently cultured from the discharge. These were taken care of by the use of zinc peroxide paste at the same time. An elderly diabetic female had an extensive mixed infection of her foot and leg with progressive sloughing. Staphylococci and anaerobic streptococci were cultured from the discharge. Sulfamethylthiazole solution locally caused the staphylococci to disappear and they never again became a feature of the infection which was later progressive and ended in death. She was unable to tolerate the drug by mouth. Other patients received the drug by mouth at the same time. The introduction of saturated solutions of the thiazoles in water or normal saline permits the exposure of certain tissues to concentrations far

in excess of those obtained for the same tissues when the drug is given orally only. The combination of the two routes should be advantageous in properly selected cases. The combination of zinc peroxide cream with saturated sulfathiazole solution deserves special attention and will probably take care of mixed infections involving the staphylococcus and anaerobic streptococci or other organisms.

DISCUSSION

At the present time, sulfathiazole is the only chemotherapeutic agent available and officially accepted that is strongly active against the staphylococcus. This study indicates that sulfamethylthiazole is at least as active. It has not been officially accepted because of some serious reactions such as neuritis. A significant reduction of the mortality in the severe staphylococcic infections including septicemia, pneumonia, and infections of the dangerous area of the face indicates the value of the thiazoles as compared with sulfanilamide and sulfapyridine.

While the reactions from sulfathiazole do not seem to be dangerous clinically and although the nausea and vomiting are of milder character and more transient, one must not be deceived into a false sense of security. Investigation with animals has demonstrated the fact that the thiazoles can produce serious kidney damage and have also shown the mechanism by which the damage is produced. Apparently free drug can be precipitated as well as the conjugated drug. The findings in animals should not, however, prejudice our clinical conclusions and I am convinced that these severe reactions are not usual when humans are being treated so that their blood level of free drug is below 10 mg. per cent. Furthermore, if some precipitation does take place in the kidney when the urinary output is normal or better, the condition is probably not irreversible. It is also my opinion that the mortality of untreated staphylococcus septicemia is so great that the risk of serious reactions is relatively inconsequential. The use of sulfamethylthiazole would be entirely justified if not for the evidence that sulfathiazole is about as efficient. Certainly the thiazoles are not drugs that can be used carelessly. Every patient receiving sulfathiazole should be carefully watched by his physician and a certain minimum of laboratory-work performed.

Although the thiazoles are active against the staphylococcus, they cause reactions and are potentially dangerous unless properly handled. There is, therefore, a need for some new drug which will be comparatively nontoxic and still more active. Until such a drug is discovered, they offer real help in the treatment of severe staphylococcic infections.

SUMMARY

One hundred thirty cases of staphylococcic infections treated with thiazole derivatives of sulfanilamide are reported. Fifty-two patients received sulfamethylthiazole and seventy-eight took sulfathiazole. The types of organisms and the conditions treated are listed. Oral, intravenous, rectal and local administration of the drugs are discussed, including indications, dosage and efficacy.

The thiazoles are rapidly excreted through the kidneys in free and combined form. Approximately 29 per cent of the sulfathiazole was acetylated by the cases in this study. The blood stream is cleared in twenty-four to forty-eight hours.

The various toxic manifestations encountered are listed and the reactions discussed. No anemia, leukopenia, renal calculi, cyanosis or neuritis resulted from sulfathiazole. Sulfamethylthiazole caused one case of lower motor neurone involvement, two cases of anemia and five cases of cyanosis. Two cases of diplopia are recorded for the first time. The management of toxic reactions is discussed.

Ninety-two and three-tenth per cent of the cases were improved; five of those who did not improve failed to show any response to treatment and the others died. The

mortality of staphylococcic septicemia in this study was 27 per cent.

Although sulfamethylthiazole has strong action against staphylococcus, it is a potentially dangerous drug. Sulfathiazole is the only efficient, accepted drug for the treatment of staphylococcic infections.

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To the physician and health official, it is of the utmost importance to know how poliomyelitis is spread. In general, there are only a few ways by which infection can be transmitted; by direct contact, or by indirect contact through objects or fomites, by insects or through the gastro-intestinal tract. If it is the gastro-intestinal tract, food, water, milk, or contact may all play a part.

TREATMENT OF FRACTURES OF THE PATELLA BY PARTIAL EXCISION OF FRAGMENTS*

LIONEL D. PRINCE, M.D., F.A.C.S.
Chief of Orthopedic Service Mount Zion Hospital
SAN FRANCISCO, CALIFORNIA

FRACTURES of the patella have always been a subject of interest and even in the earliest books on surgery much was written on the different methods of treatment. In the work of Ambrose Paré, fracture of the patella or whirlbone was recognized as a serious injury. Paré after reduction advised that the patient "must lie or keep in bed for at least forty days." He stated his prognosis as follows: "I have seen none of those who have had this bone fractured who have not halted the rest of their lives." Over sixty years ago Lister performed an open reduction on a fractured patella using wires to approximate the fragments. The operative result was satisfactory and this method of treatment was considered a great triumph for the antiseptic theory advocated by him.

It is unnecessary at this time and not the purpose of this paper to enumerate the various methods of treatment that have been advocated and used for years by surgeons in the open reduction of the fractured patella. At the present time the basic principle of the operative procedure is the approximation of the fragments and surrounding soft tissue and their fixation by the use of absorbent and nonabsorbent material. The results, generally speaking, have been very satisfactory but in a certain percentage of cases, due to poor osteogenetic properties of the patella, delayed or nonunion has occurred, necessitating further surgery. Likewise in the conservative treatment, as shown by John Cowan, nonunion not infrequently is the result of interposition of the tendinofibrous capsule between the patellar fragments.

It has been the occasional experience of surgeons to find in individuals upon whom they have operated for fractures of the patella that a relatively long period of disability results. At times even in those cases in which solid bony union has been obtained, there is a certain amount of permanent disability. This has been largely due to the fact that there has occurred posttraumatic disturbance on the articular surface of the patella either as a result of traumatic arthritis or as the result of some inexactness in the alignment of the fragments, producing a jog or irregularity along the fracture line.

In addition, in some cases union may be unusually slow, necessitating a long period of immobilization. As a result marked stiffness in the knee joint associated with atrophy and weakness in the quadriceps muscle occurs, and the disability of the patient may be definitely protracted.

In 1935, J. E. M. Thomson advocated the removal of the small fragments of the patella suturing the tendon directly to the larger fragment. He reported a series of five cases stating that the results in each instance were uniformly satisfactory. Of great interest is the article by R. Brooks published in 1937 in the British Medical Journal on treatment of fractures of the patella by excision. In his article he states that the patella is part of the skeleton philogenetically inherited and that there is no evidence that its development is in response to a functional need. The patella is not a sesamoid bone and as shown by previous observers is not situated or developed in the quadriceps tendon but is

* From the Orthopedic Service Mount Zion Hospital, San Francisco. Read before the Section on Industrial Surgery of the California Medical Association at Coronado, California, May 6 to 9, 1940.

independent behind the tendon. Brooks further states that the patella has an inhibitory action on motion in the knee and that in fast moving animals as the fox, deer and leopard the bone is small, while in slow moving animals such as sloths and moles the bone is massive and proportionately well developed. The quadriceps muscle itself has no influence on the development of the patella and in the kangaroo, in which the quadriceps is markedly developed, the patella is completely absent.

Through experimentation he advanced evidence that in the absence of the patella the efficiency of the knee joint in man is actually increased. Brooks, in his article, advocates the total removal of the fractured patella and reports a series of cases with very satisfactory results.

Hey Groves, of Bristol, in commenting on Brooks' article, in which he admits his reaction was one of "frank incredulity," following a personal review of the cases, found that claims of Mr. Brooks having restored these people to complete functional activities by excision of the patella were fully justified. He convinced himself of the rationality of this treatment by anatomical investigation in which it was shown that the lateral expansions of the quadriceps tendon to either side of the patella are the essential part of the tendon requiring repair following fractures of the patella. In severe transverse fractures of the patella these lateral expansions of the quadriceps tendon are torn and he believed that with the removal of the fractured patella a much firmer and more complete repair of the torn tendon could be made.

The works of Brooks and Tippett have been mentioned in some detail in this paper in order to emphasize the radical procedure which is now being advocated in treatment of fractures of the patella. The excision of the entire patella would appear to be an extremely radical procedure particularly to the majority of surgeons who have been treating fractures of the patella according to acceptable routine methods and who have been trained to conserve any damaged tissue that is likely to survive.

Anatomical replacement is an essential step to restoration of function and we are reluctant to accept any extremely radical procedure until this procedure is verified by sufficient clinical evidence. We, in our series, have not as yet employed total excision of the patella in treatment of fractures of this bone but we have for a number of years used the method of partial excision of the fragments with suture of the patellar tendon directly to the proximal fragment. The type of fracture has varied from the simple transverse fracture in which there are two large fragments, to the more common type in which there is one large upper fragment and several comminuted lower or distal fragments. This latter type of fracture is frequently seen as the result of automobile accidents in which the knee of the occupant is brought violently against the instrument panel, the so-called dashboard fracture.

OPERATIVE TECHNIC

We have performed this operation under general, local and spinal anaesthesia and the use of a tourniquet is not necessary as hemostasis is easily controlled. The elliptical incision below the patella is in our experience the best method of approach. On exposure of the patella (Fig. 1) the lower fragment or fragments are cut away from the tendon, care being taken to disturb the tendon as little as possible. Likewise the operative field is scrutinized for small bony fragments and blood clots, removal of which are essential. The upper fragment is carefully inspected for intactness and with a rongeur the edges are smoothed and rounded. With a chisel or sharp elevator the fibrotendinous layer on the superior surface of the patella is elevated without disturbing its intactness. Three holes (Fig. 2) are then drilled equidistant through the upper surface of the patella downward and forward to emerge on the fractured surface of the fragment just above the articulating cartilage. All

frayed and shredded portions of the patellar tendon are cut away and the tendon affixed to the fragment by means of two mattress

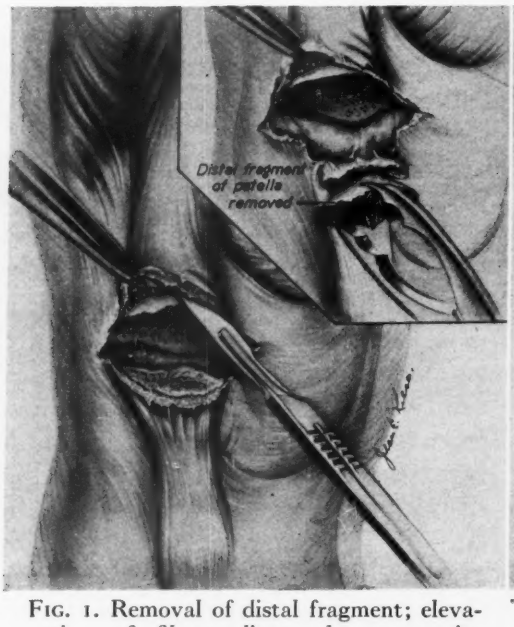

FIG. 1. Removal of distal fragment; elevation of fibrotendinous layer superior surface of proximal fragment.

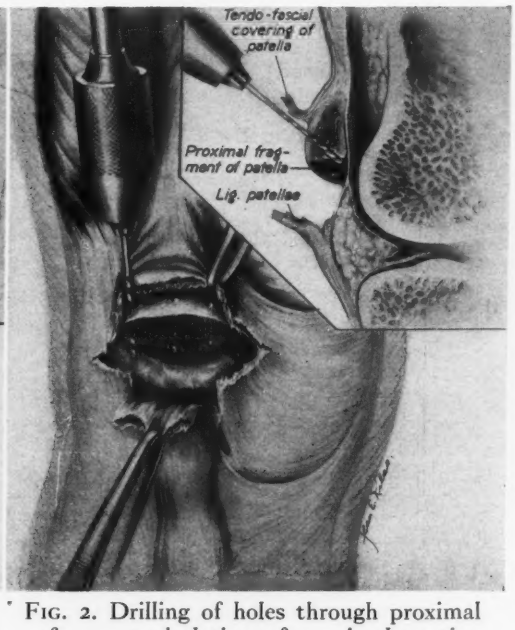

FIG. 2. Drilling of holes through proximal fragment; isolation of proximal portion of patella tendon.

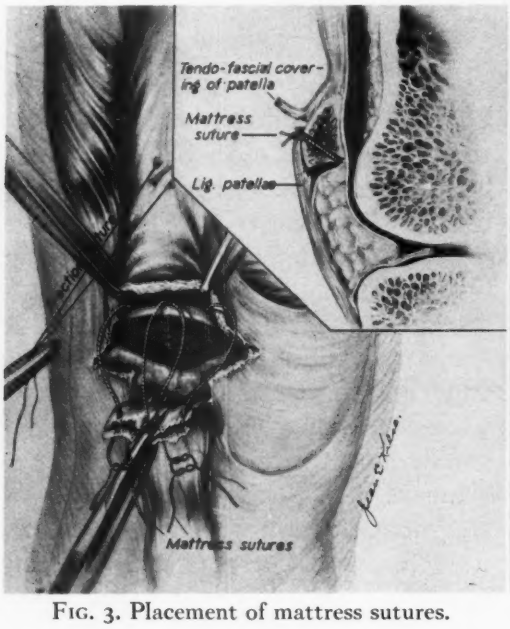

FIG. 3. Placement of mattress sutures.

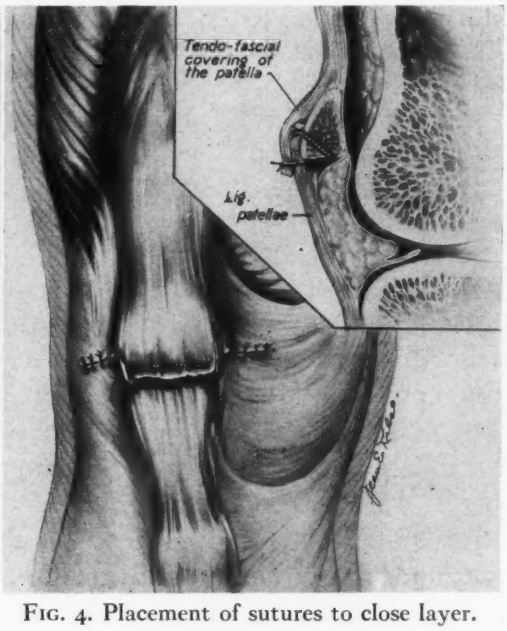

FIG. 4. Placement of sutures to close layer.

sutures employed in such a fashion that the tied knots lie on the superior surface of the patella. (Fig. 3.)

In our early cases we used silk but we now use No. 2 or No. 3 chromisized catgut. It was found, occasionally, several months after the operation, with primary healing, that a foreign body reaction to silk necessitated the removal of several sutures. Our experience with stainless steel wire has been limited, but this suture material may be ideal for this procedure. The fibrotendinous layer over the patella (Fig. 4) is then attached by means of interrupted mattress sutures to the patellar tendon itself, the fascia overlapping the tendon. The lateral portions of the tendon and

capsule on either side of the patellar fragment should be carefully approximated by interrupted sutures. The operation can be greatly facilitated by affixing a temporary guy suture of braided silk to the quadriceps tendon just above the patella. (Fig. 3.) Traction on this silk strand by an assistant permits easy approximation of the patellar fragment to the tendon during the process of suturing. Following closure of the wound the knee is immobilized with either a light cast or posterior metal splint extending from the upper third of the thigh to the lower third of the calf. This splint or cast may be removed in two or three weeks and replaced by an ace bandage. In our early cases a splinting support was used for several weeks but we learned that the convalescent period could be shortened by early weight bearing and exercising of the

Fig. 5. Fractured patella preoperatively.

Fig. 6. Fractured patella postoperatively.

Fig. 7. Incomplete union with malposition of patella fragments preoperatively.

Fig. 8. Postoperative appearance.

knee joint. We now allow the patient to walk in ten to twelve days and permit joint motion in the third week.

In our series of fourteen cases the results have been uniformly satisfactory. The majority of our cases is comprised of simple or slightly comminuted fractures of the patella. (Figs. 5 and 6.) In one case, however, as the result of a severely compounded fracture of the patella with loss of the upper half, a satisfactory, stable and painless knee was subsequently obtained by fixing the quadriceps tendon to the distal fragment. Excellent extension with flexion past 90 degrees was obtained, ultimate complete recovery being prevented by some damage to the knee joint itself and the long period of preoperative immobilization. I believe in cases of this type as well as cases of severely comminuted fractures of the patella, that the excision of the entire patella would be the rational procedure. The operation is also of value in those cases of malunion or nonunion of the patella in which painful symptoms in the knee joint persist. In one of our cases with marked deformity of the patella resulting from mal- and incomplete union of the patellar fragments (Figs. 7 and 8) an excellent result was obtained by removing the distal fragment and suturing the patellar tendon to the proximal fragment.

Satisfactory results of the operation or rapidity of convalescence has in no way been jeopardized by late operative interference which has been necessary in a limited number of our cases due to superficial trauma about the knee joint. Following our operation the contour of the knee joint is not appreciably changed by removal of the patellar fragment or fragments. In addition the presence of the patella as a protective mechanism of the knee and the articular surface of the femur is maintained. This may be of considerable importance in those individuals whose occupations require constant kneeling.

CONCLUSIONS

1. Partial excision of the patella for fracture with restoration of the extensor apparatus of the knee by suture of the patellar tendon to the proximal fragment has given uniformly satisfactory results.

2. The period of disability is definitely shortened with rapid restoration of function in all uncomplicated cases.

3. The uncertainty of union due to the low osteogenitic properties of the patella and the protracted disabilities that may result from the long period of immobilization necessary to obtain union is obviated.

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THE DARRACH OPERATION FOR LOWER RADIO-ULNAR DERANGEMENT*

DENMAN C. HUCHERSON, M.D.
Fellow in Orthopaedic Surgery, University of Oklahoma School of Medicine
OKLAHOMA CITY, OKLAHOMA

IN 1936, in a volume dedicated to Dr. Albin Lambotte of Brussels, Dr. William Darrach described an operative procedure for restoring derangement of the lower radio-ulnar relationship, which merits a much wider use than now is accorded it.

INDICATIONS

The operation was devised for any condition which interfered with the normal articular relationship of the radius and ulna at the wrist joint. The author noted in his original article the fact that any injury

FIG. 1.

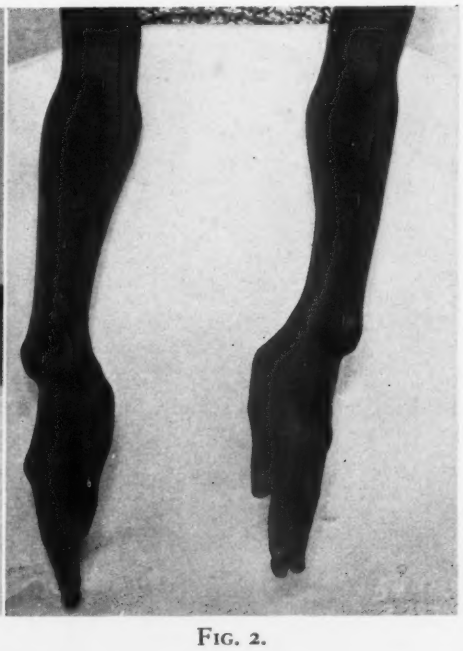

FIG. 2.

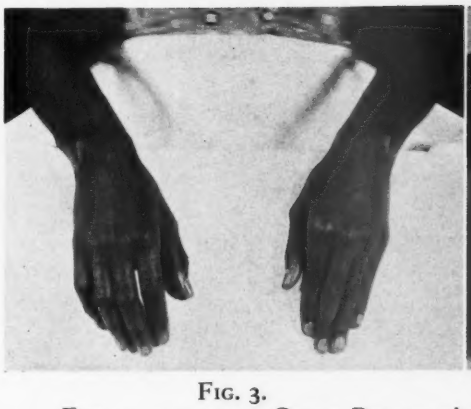

FIG. 3.

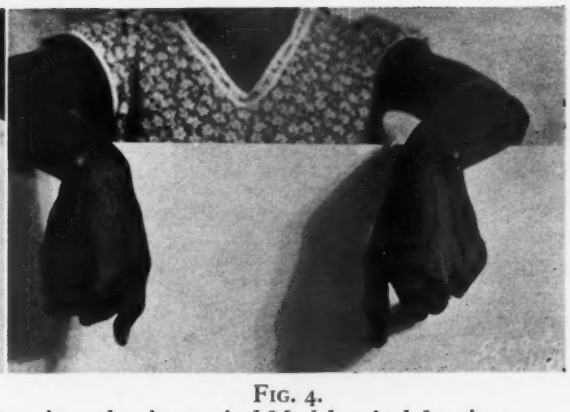

FIG. 4.

FIGS. 1, 2, 3 AND 4. Case 1. Preoperative views showing typical Madelung's deformity.

* From the Service of Dr. Paul C. Colonna.

of the radius resulting in its shortening will produce pain, limitation of motion and often deformity at the wrist. This is seen most frequently following Colles' fracture with impaction, fractures of the shaft of the radius that heal with overriding or angulation and dislocations of the wrist in which reduction has been delayed. Likewise, a similar wrist deformity is produced by disease or injury of the radial epiphysis with maldevelopment of the epiphyseal structure and continued growth of the ulna. For instance, this is seen most strikingly in Madelung's deformity.

We have found the Darrach operation of extreme value in correcting these wrist deformities as shown by the following patients treated on the Orthopaedic Service at the University Hospital.

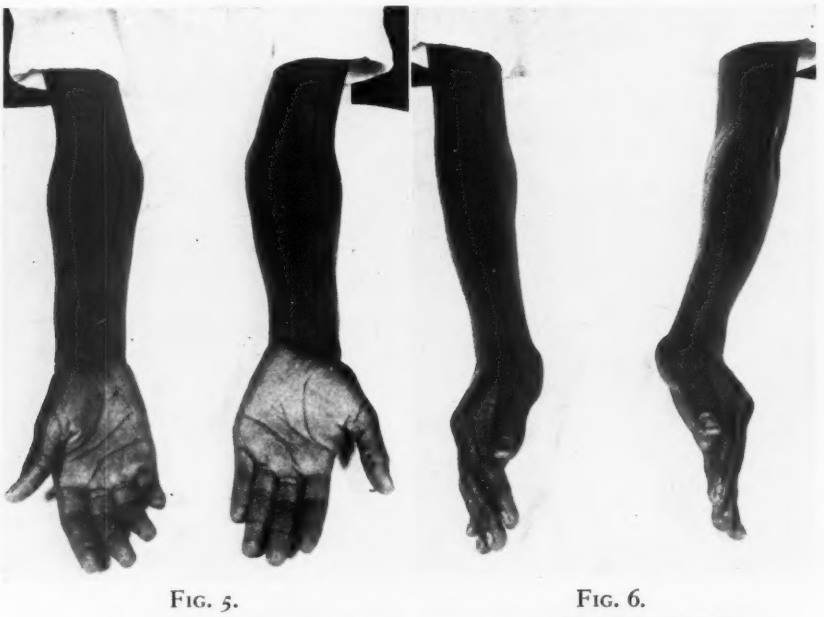

Fig. 5. Fig. 6.

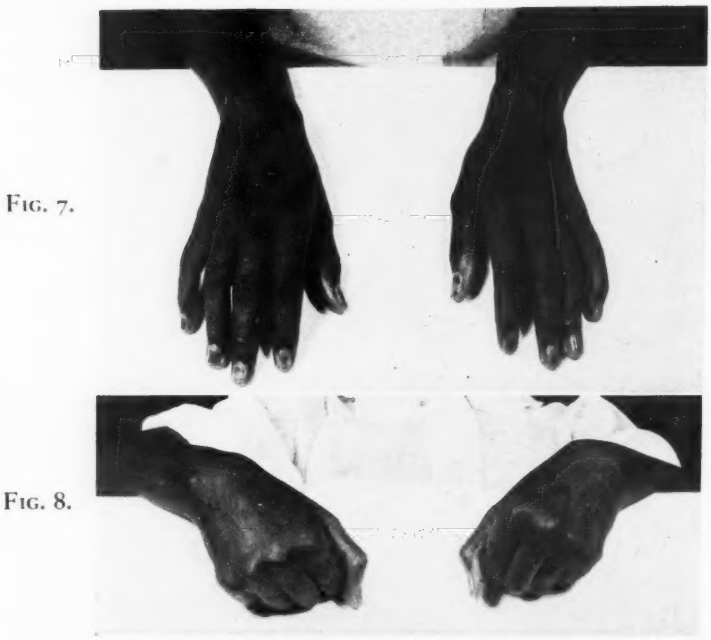

Fig. 7.

Fig. 8.

Figs. 5, 6, 7 and 8. Case 1. Postoperative views taken approximately four months following the last operative procedure.

TECHNIC

The operation is as follows: An incision is made longitudinally on the ulnar aspect of the forearm, extending from the tip of

the ulnar styloid upward. The incision is carried down to the periosteum between the flexor and extensor carpi-ulnaris tendons. Care must be taken to avoid the dorsal branch of the ulnar nerve. The periosteum is then reflected from the lower portion of the ulna and the bone is cut across obliquely, leaving a sloping margin to the proximal fragment. The lower fragment is then turned out of the wound and the attachment of the capsule can be divided close to the articular cartilage. The ulnar styloid is then cut across at its base and left behind with its attached collateral ligament. The periosteum is then closed and will provide an attachment strong enough to prevent abduction laxity. Regeneration of bone in the periosteal sleeve varies.

Fig. 9 Fig. 10.

Figs. 9 and 10. Case I. Anteroposterior and lateral views of both wrists preoperatively.

CASE REPORTS

The following cases are presented to show the efficacy of this operation:

Case I. M. M., a colored female, age fourteen years, was first seen in the Out-Patient-Department on February 17, 1940. The patient complained of a deformity of both wrists and forearms which was associated with increasing weakness and pain. There had been no attempt at treatment and she stated that she had not been conscious of her condition until three years previously.

Examination revealed the typical deformity of Madelung with marked prominence and subluxation posteriorly of the head of the ulna and bowing anteriorly of the radius. Styloids of both bones were on the same level. There was the usual limitation of dorsiflexion of the hands and supination of the forearm. Radial deviation was definitely limited by bony block, but ulnar deviation was normal.

On February 24, 1940, the Darrach procedure was carried out on the right ulna and, through a second incision, a wedge osteotomy was done through the distal epiphyseal plate of the radius. Postoperative *x*-rays showed satisfactory correction of the deformity, but an osteotomy two inches above the first was decided upon to correct completely the bowing of the radius. This was done March 16, 1940, and postoperative *x*-ray showed excellent correction of the deformity. The left wrist was operated upon on May 18, 1940, the Darrach operation being combined with an osteotomy of the radius, done at the point of greatest bowing.

The patient was last seen in the Out-Patient-Department on June 25, 1940, at which time both wrists showed a good cosmetic and functional result, with solid bony union at the site of the osteotomies.

Case II. C. M., a white male, twenty-seven years of age, was first seen in the Out-Patient-Department on July 6, 1940, complaining of loss of grip in the hand, pain and deformity of the wrist. The patient sustained a fracture of the right radius September 26, 1939, while cranking a car. An open reduction was performed, at another hospital, on September 29, 1939.

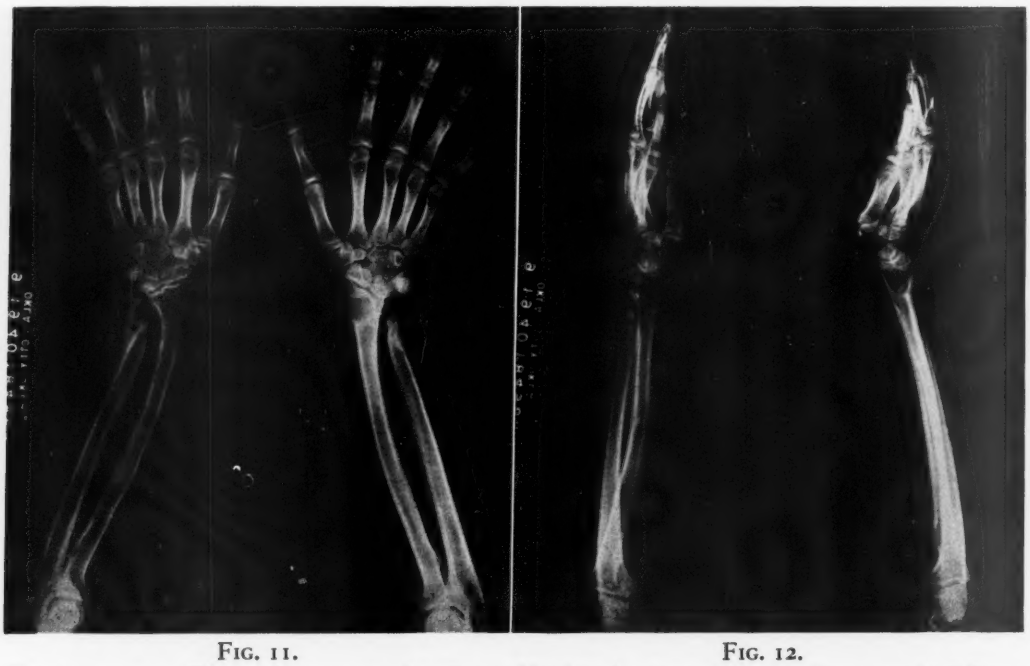

FIG. 11. FIG. 12.

FIGS. 11 AND 12. Case I. Anteroposterior views of both wrists approximately four months following completion of the last operative procedure. Note the regeneration of bone and the periosteal sleeve of the right ulna.

FIG. 13. Case II. Anterior and posterior views of the right forearm as taken on first admission to the hospital. Note the marked radial deviation of the hand and also of the distal end of the ulna.

FIG. 14. Case II. Anterior and posterior views which were taken six weeks postoperatively. There is complete correction of the radial deviation of the hand.

Examination revealed that the hand deviated markedly toward the radial side. There was evident shortening of the radius with nonunion about two inches proximal to the styloid process in the shaft of the radius. The lower extremity of the ulna was prominent and was evidently dislocated from its articulation with the radius. Rotation was restricted about 50 per cent and the forearm was held in an attitude of pronation. There was no disturbance of muscle power, but the grip was weak because of mechanical malposition.

On July 9, 1940, a Darrach type operation was done on the right ulna, an open reduction of the radius was performed and a plate applied. Postoperative *x*-rays showed a good correction.

The patient was last seen on August 14, 1940 at which time the hand was in excellent position.

CONCLUSION

The Darrach operation is an excellent operative procedure and one that will be found most valuable in correcting disturbances of the lower radio-ulnar relationship.

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This disease (poliomyelitis) affects primarily the central nervous system. Although there is diffuse and usually extensive involvement throughout the brain and spinal cord, it appears that the virus has a peculiar affinity for the motor nerve cells of the cord, particularly the cells of the lumbar and cervical regions.

ACUTE APPENDICITIS IN YOUTH AND OLD AGE*

WOOLFOLK BARROW, M.D.
Consulting Surgeon, Eastern State Hospital
LEXINGTON, KENTUCKY

ACUTE appendicitis in youth and old age is of far greater diagnostic and therapeutic importance than the number of patients so afflicted would indicate, because a disproportionately large percentage of the total number of deaths from acute appendicitis occur in the extremes of life. Our experience has been similar to that of others in that the mortality rate of acute appendicitis has been highest in those ages in which the incidence has been least and vice versa. It may be on account of this very scarcity of acute appendicitis in patients less than ten or more than sixty years of age that there is such a high mortality rate in these ages. In these patients acute appendicitis may not even be considered as a possible cause of abdominal pain.

Acute appendicitis is most frequently encountered in adolescence and early adult life, but it does occur in every decade with sufficient frequency to be of diagnostic and therapeutic importance throughout the life span. It has been reported in an infant of twelve days by Ham[1] and in an infant of three weeks by Pope.[2] In our experience the incidence has increased steadily with increasing age until a peak was reached about the twentieth year; thereafter it decreases slowly. (Fig. 1.)

We have encountered patients more than eighty and less than two years of age with this disease. Of 1,039 consecutive patients with acute appendicitis previously reviewed[14] there were one hundred of either less than ten or more than sixty years of age, or 9.6 per cent of the total number. Of this one hundred patients, sixteen died, or a mortality rate of 16 per cent. Of the 939 patients between ten and sixty years of age, 137 died, or a mortality rate of 4.2 per cent. To express it differently, 29 per cent of the total number of deaths from acute appendicitis and its complications occurred in patients of less than ten or more than sixty years of age, although this group formed less than 10 per cent of the total number.

Similar findings have been reported in the literature. For example, Pattison[3] found that over 40 per cent of the deaths from acute appendicitis occurred in the extremes of life. Cole[4] reported a mortality rate in children (7.9 per cent) with appendicitis (acute and chronic) almost four times that in adults (2.16 per cent). Stone[5] reported similar findings. Allen[6] reported a mortality rate of 15.27 per cent in infants. Collins[7] noted that "The mortality rate (of acute appendicitis) increased appreciably in the first and after the fifth decade of life." Koonce[8] found the mortality rate of acute appendicitis 12 per cent in the first decade, 1 per cent in the third decade and 42 per cent in the seventh decade. Keyes[9] and Bower[10] report essentially similar findings.

In our experience the mortality rate associated with acute appendicitis in every age group has been more closely related to the incidence of appendiceal peritonitis than any other single factor. (Fig. 2.) Death of patients with acute appendicitis operated upon prior to perforation of the vermiform process has been rare. Of the one hundred patients less than ten or more than sixty years of age considered here, forty-one or 41 per cent had appendiceal pus in the peritoneal cavity at the time of entry at the hospital. In patients with acute appendicitis between ten and sixty years of age, 14.5 per cent had appendiceal peritonitis. In our

* From the surgical services of the Lexington Clinic, Lexington, Kentucky, and of the Charity Hospital, New Orleans, Louisiana.

opinion the high mortality rate associated with acute appendicitis in youth and old age is dependent upon the high incidence of appendiceal peritonitis encountered in these patients. If every acutely inflamed appendix had been removed prior to perforation, regardless of the age of the patient, death from acute appendicitis would have been rare.

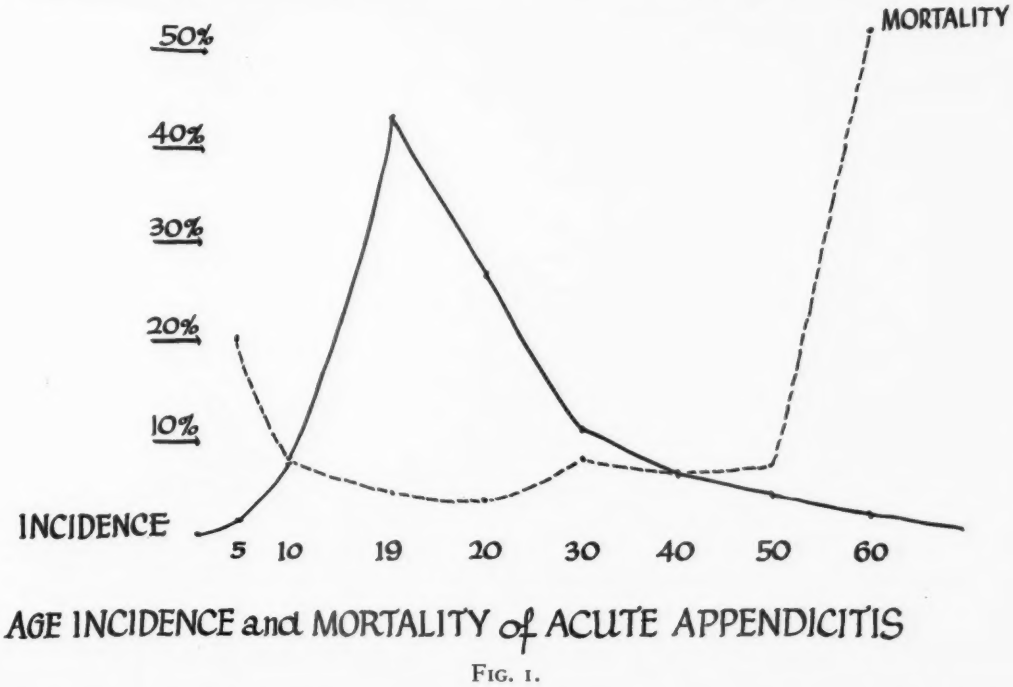

Fig. 1.

The factors responsible for this high incidence of perforation and indirectly the high mortality rate in the very young or the very old patient with acute appendicitis, as elsewhere, seems to be first, delay in treatment, and second, catharsis. An analysis of these patients does not support the belief that perforation occurs more rapidly in youthful patients. In patients of all ages with acute appendicitis, perforation had occurred in 4 per cent of the patients seen within twenty-four hours after the onset of symptoms; in children under ten, perforation had occurred in 6 per cent of the patients less than ten years of age seen within twenty-four hours of the onset of symptoms. In view of the small number of patients in each of these groups it is doubtful that this difference is of statistical significance. When these patients are further analyzed by the percentage of patients with appendiceal peritonitis in respect to the time elapsing between onset of symptoms and hospitalization in the two groups of patients (youth and old age versus adolescence and early adult life) there is but little difference. (Fig. 3.) The sole cause of the increased incidence of appendiceal peritonitis and the increased mortality in youth and old age is apparently the greater interval which elapses, on the average, between the onset of symptoms and the institution of correct therapy. (Fig. 4.)

Why delay in hospitalization should be encountered more frequently in youth and old age than elsewhere is not entirely clear, but there are several factors which seem to play a part. In the first place, delay in the institution of treatment may be occasioned by failure of the patient or his family to summon medical aid, a failing particularly easy to understand in youth and old age when one remembers the frequency of abdominal pain arising from self limited disease in these age groups. In adolescence and early adult life, acute appendicitis is one of the more frequent causes of abdominal discomfort; and abdominal pain, regardless of its origin, immediately suggests

acute appendicitis to the patient and his family. In children, on the other hand, "green apple colic," gastroenteritis, mesenteric adenitis, or the acute exanthemas are much more frequent causes of abdominal pain than acute appendicitis and the former are first suspected as the cause of the patient's complaints—acute appendicitis usually only after complications have occurred. Only by *continuous* suspicion on the part of the patient's family and *repeated* examination by the physician can such mistakes be avoided.

This frequency of abdominal pain due to self limited disease in children has another and no less important effect. When medical aid has been summoned two or three times for abdominal pain which was not appendiceal in origin, the family soon becomes reluctant to call a physician for a complaint which seems similar to that suffered previously, although the cause may be entirely different. In other instances, catharsis has been found to be an effective method of relieving most types of abdominal pain in children and may have been prescribed at one time or another by a physician. Conditioned by these experiences it is not unnatural that when abdominal pain comes again, even though it may be due to acute appendicitis, for the family to understandably hesitate to call a physician and they may even administer a purgative. In patients less than five years of age perforation of the vermiform appendix had occurred in 73 per cent at the time of entry at the hospital.

In elderly patients the same situation has been found to exist. In these patients, obstipation and dyspepsia are much more frequent causes of abdominal discomfort than acute appendicitis. Indeed, some elderly patients have almost continuous mild abdominal discomfort which they have learned to disregard entirely. Added to this, in patients past sixty, sensibility to abdominal pain is apparently reduced and, therefore, the clinical manifestations of

Age	Mort. Entire Group	Per Cent Perf.	Mort Perf.	Mort Unperf.
0-4	18%	73	25%	0
5-9	7%	25.3	27%	0
10-19	3.6%	14.6	25%	0
20-29	3.2%	12	15.6%	1.5%
30-39	7.6%	16	36.8%	2%
40-49	5.5%	24	23%	0
50-59	6%	27	22%	0
60-Plus	50%	77.2	60%	0

ANALYSIS of PATIENTS with ACUTE APPENDICITIS by AGE GROUPS

FIG. 2.

acute appendicitis have been more easily ignored. It is no surprise that the vermiform appendix is rarely suspected as the cause of

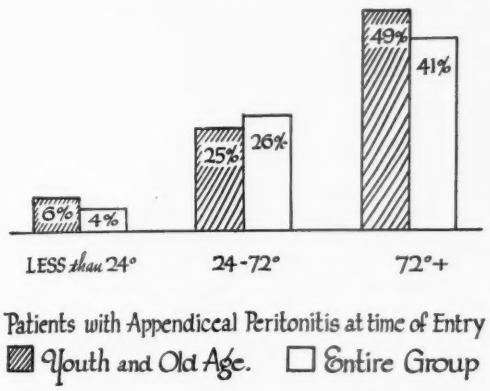

Fig. 3.

rotomy, and only by the frequent use of exploratory laparotomy in patients with "suspected acute appendicitis" can many

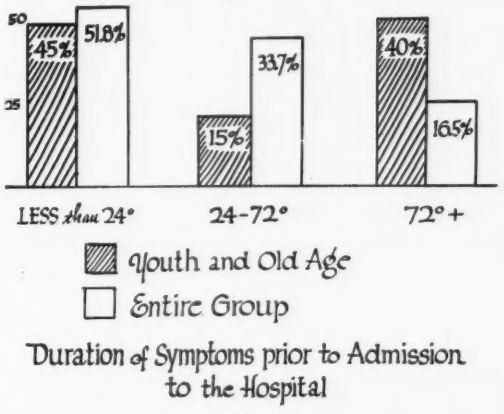

Fig. 4.

an elderly patient's discomfort until the disease is far advanced. Perforation of the appendix had already occurred at the time of entry in 77.2 per cent of the patients past sixty years of age with acute appendicitis. Abdominal pain at any age may be due to acute appendicitis, and in our opinion should be so considered until proved otherwise by exploratory laparotomy, if necessary, regardless of the age of the patient.

In the second place, increased difficulty in differential diagnosis in the very young and the very old patient with abdominal pain probably contributes to delay in hospitalization and the high incidence of appendiceal peritonitis. In our experience, in only approximately 50 per cent of all patients of all ages with acute appendicitis can the diagnosis be made with certainty from the history, physical examination and the laboratory findings. In the remaining one-half of the patients, the diagnosis of "acute appendicitis" must be made by exclusion of other conditions which might be responsible for the patient's complaints. This may be a very simple procedure in the young man of eighteen but rapidly becomes more difficult as the extremes of life are approached. In youth and old age there are many pathologic conditions, commonly encountered, which may prove confusing. In many instances it is impossible to settle the diagnosis except by exploratory laparotomy, and only by the frequent use of exploratory laparotomy in patients with "suspected acute appendicitis" can many patients be saved the dangers and discomfort of appendiceal peritonitis. When it is impossible to exclude the vermiform appendix as the cause of the patient's distress, in our opinion exploratory laparotomy is not only justifiable but is mandatory. The child of seven who develops the rash of measles on his first postoperative day will recover. The patient with mesenteric adenitis is benefited by the removal of the appendix. In the same way, the life of the older individual in whom the appendix does not prove to be the cause of his symptoms has been jeopardized but little by exploratory laparotomy. On the other hand, had these patients been allowed to retain an acutely inflamed appendix—and the symptoms may, at times, be such that exact diagnosis is impossible—serious sequelae are to be expected. The free use of exploratory laparotomy, in our experience, has been the only possible way to avert tragedy in certain patients with acute appendicitis. In those patients in which the appendix was not at fault, there was not a single death and the stay in the hospital was less than ten days with few exceptions. Exploratory laparotomy in these patients was a matter of inconvenience, not of danger. On the other hand, in six patients with acute appendicitis who were treated on nonsurgical wards due to an error in diagnosis there was a mortality rate of 100 per cent. In-

deed, there is nothing which offers the patient with acute appendicitis so poor an outlook as a persistent error in diagnosis.

It is true that in youth and old age acute appendicitis may prove to be the cause of abdominal pain less frequently than in young adults, but we believe that exploratory laparotomy should be undertaken on the same indications in these age groups as in others, i.e., inability to rule out the vermiform appendix as the cause of the patient's discomfort. It is better to perform exploratory laparotomies on several patients without acute appendicitis than to allow one patient to go on to perforation. Let us repeat, that not a single death occurred in any age group in which exploratory laparotomy failed to reveal an acutely inflamed appendix as the cause of the patient's symptoms.

In our opinion, the treatment of patients with acute appendicitis in the extremes of life should, with few exceptions,[13,14] follow those principles already found most satisfactory in other age groups. Ideally, this consists in removal of the appendix before infection has spread beyond its confines. When the process has spread to the peritoneal cavity and localized abscess has occurred, we agree with Lehman and Parker,[11] among others, that supportive measures are preferable to immediate surgery unless active interference is demanded by a progressively rising pulse or increasing fever. In instances in which a localized abscess had formed in children, Miller, Fell, and Brock[12] found that resolution occurred in 89 per cent without surgical interference, and it was possible to remove the appendix during a quiescent stage.

In patients with generalized peritonitis there is the greatest difference of opinion in regard to the most satisfactory treatment. In our experience, whether or not immediate or delayed surgery has been undertaken, it is of the utmost importance to institute promptly and carry out faithfully those measures designed to correct the derangements in normal physiology[13,14] which consistently occur in these patients. These have been outlined previously in detail elsewhere.[15] One of the most important of these is physical rest for the patient, which may be obtained only with difficulty in the very young patient.

CONCLUSIONS

1. The mortality rate of acute appendicitis in youth and old age has been approximately four times the mortality rate in adolescence and early adult life.

2. This increased mortality rate in youth and old age does not seem to be due to a peculiarity of the disease itself in these age groups but rather to the greater delay encountered, on the average, in the institution of treatment, and a consequent increase in the incidence of appendiceal peritonitis.

3. In our experience, this delay in the institution of treatment in patients with acute appendicitis in youth and old age has been due first to reluctance of the patient or his family to summon medical attention due to previous experience with self limited disease associated with abdominal pain which seem similar to that of acute appendicitis, and second, increased difficulty in differential diagnosis in these age groups.

4. Constant suspicion of the appendix as a cause of abdominal pain at any age by family and physician as well as more frequent exploratory laparotomy in patients in whom the diagnosis is doubtful are suggested.

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The pathological changes (in poliomyelitis) most commonly involve the lower motor neurons. This fact is demonstrated clinically by flaccidity of the muscles of one or both legs, one or both arms, both arms and legs, arms and trunk, legs and trunk, trunk alone, or the whole body. Paralysis rarely involves the upper motor neurons and rarely produces spasticity.

A METHOD FOR PREVENTING OR DIMINISHING PERITONITIS FROM LEAKAGE AFTER INTESTINAL RESECTION OR PERFORATION

HARRY KOSTER, M.D., F.A.C.S.
BROOKLYN, NEW YORK

CASE 1. A female patient, aged twenty-seven, with tuberculosis of the cecum had a resection of the terminal ileum, cecum and ascending colon with an ileotransverse colostomy on May 28, 1940. The anastomosis (three layers) was easily done on normal healthy bowel and seemed perfectly satisfactory. On the third day after operation the temperature was at 101°F. all day. On the fourth day it began to rise reaching 102.5°F. On the fifth day it rose to 103.8°F. She began to vomit, developed distention, tenderness and rigidity in the abdomen, and expired on the sixth day.

The postmortem findings were: Feces in the peritoneal cavity from a leak on the anterior surface of the ileotransverse colostomy through which a probe could easily be passed into the bowel lumen. (Fig. 1.)

In recent years many methods have been devised to perform anastomosis of various parts of the gastrointestinal tract aseptically so as to diminish the mortality resulting from the peritonitis attendant upon infection by spill of content. Yet peritonitis following leakage from a suture line, even after an aseptic anastomosis has been performed, still exacts a heavy toll. Continuous seepage of bowel content into the peritoneal cavity beginning hours or days after the abdomen has been closed on what seemed to be a perfect anastomosis is responsible for most deaths from peritonitis after intestinal resection, and not the soiling at the time of operation. The peritoneum withstands the average operative soiling easily. In this respect its ability to protect itself may be likened to the ability of the blood to free itself from bacteria unless a fairly continuous supply from an open focus is maintained.

This dangerous complication can be avoided by the simple expedient of exteriorizing the anastomosis and closing the wound around it.[1] Within a few hours the peritoneal cavity is sealed. If leakage occurs subsequently, the peritoneum is safe from infection and the suture line can be repaired electively. When it is certain that the bowel junction has completely healed, the exteriorized bowel may safely be returned to the peritoneal cavity. This principle applies to the entire intestinal tract excepting the rectum and rectosigmoid and may also be applicable in occasional instances to gastric anastomosis.

This procedure has as yet not been done often enough to determine whether or not all exteriorizable anastomosis should be so treated. However, the case just cited demonstrates the lack of suitable criteria for establishing the safety of an anastomosis. It is obvious, however, that in any instance in which there is reason to doubt the security of the anastomosis and to fear leakage, a very important safeguard can be given the patient by exteriorizing the questionable loop of bowel, until definite assurance is obtained that leakage will not occur. If leakage is to occur, let it occur outside the peritoneal cavity.

The same principle is applicable also to certain perforated localized lesions of the exteriorizable portion of the gastrointestinal tract. In such cases, if it is not possible to close the perforation, or if after closure the security of the suture line is doubted, as for example in perforated diverticulitis

with marked induration, exteriorization prevents increasing the already existent peritonitis. Then when the perforation has closed spontaneously (Case II) or after subsequent suture (Case IV), the loop is reposited in the peritoneal cavity.

TECHNIC

After the anastomosis has been completed it is wrapped in a lap sponge and held out of the abdomen. It is preferable to have it protrude at one of the angles of the wound, but occasionally intraperitoneal attachments will necessitate its protrusion through the middle. In either case the wound is closed around the protruding bowel in the usual manner. The bowel is then loosely wrapped in saline-wetted gauze covered by rubber tissue, and the dressings are fixed to the abdominal wall by adhesive. The dressings are changed daily until reposition is decided upon. The exteriorized bowel is thoroughly washed with normal saline solution. The abdominal wall is dried and painted with an antiseptic solution, (our preference is for 6 per cent picric acid in 50 per cent alcohol and 10 per cent acetone), and the loop is freed from the margins of the incision by a combination of sharp and blunt gauze dissection. It is dropped into the cavity and the wound is closed by a few through-and-through sutures of black silk.

In the case of a perforation of the bowel the involved loop is similarly exteriorized and the wound closed loosely around it. Occasionally, (Fig. 2) it will be found advantageous to pass a glass rod through the mesentery of the loop to facilitate maintaining it outside the abdominal cavity.

Brief abstracts of operative procedures illustrating the use of this method in various conditions, e.g., diverticulitis of the sigmoid colon, appendicitis, resection of small bowel, resection of large bowel are presented as illustrative of the fourteen cases in which we used this method.

Case II. A male, aged fifty-two, was operated upon with the provisional diagnosis of perforation of the sigmoid from carcinoma or diverticulitis. Through a left lower rectus incision the sigmoid was found adherent to the

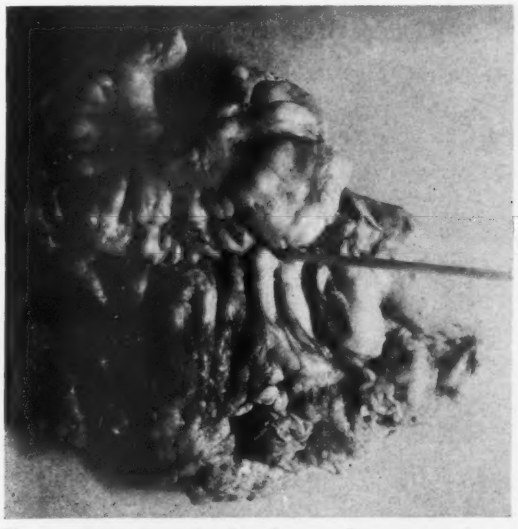

Fig. 1. Anastomosis showing probe passing into bowel lumen through a defect from which continuous leakage produced a fatal peritonitis (after immersion in formalin).

left pelvic wall and covered by adherent omentum, walling off a perforation of a sloughed off diverticulum. The bowel around the gangrenous perforation was markedly indurated and could not be closed by suture. The sigmoid was mobilized by cutting the outer leaf of its peritoneal attachment to the posterior abdominal wall, exteriorized and held out of the abdomen on a glass rod placed through its mesentery. Three strips of wet gauze were used to pack off this loop from the peritoneal cavity and the wound closed around the loop and gauze. The exposed bowel was covered with saline-moistened gauze and rubber tissue to prevent drying by evaporation. The fluid balance was adequately maintained, and the dressings changed daily, and after a stormy course for four days he convalesced satisfactorily. The exposed bowel became covered by a slightly yellowish exudate which was kept at a minimum by normal saline wet dressings. Feces continued to discharge from the perforation which became progressively smaller until on the seventeenth day it was completely closed. Two ounces each of water and glycerin used as a retention enema was effectual on the fourth day following operation, and thereafter bowel movements were obtained either by mineral oil, enemas as above or both. On the sixth day all gauze pack-

ings were removed. On the fourteenth day the glass rod was removed. On the fifteenth day a tendency for the sigmoid to recede into the abdominal cavity was noticed. The recession progressed very slowly. The temperature was normal. On the twenty-fifth day after washing the loop of bowel with saline and then preparing the surrounding skin, the loop was dissected free from the abdominal wall and reposited in the peritoneal cavity. During the dissection dense adhesions of the ileum to the abdominal scar were encountered and in their separation the ileum was torn. Four inches of ileum was resected and an end-to-end anastomosis over soft clamps was done and the wound closed. Convalescence was uneventful excepting for a late wound infection which cleared after incision, and the patient was discharged cured on March 11, 1935.

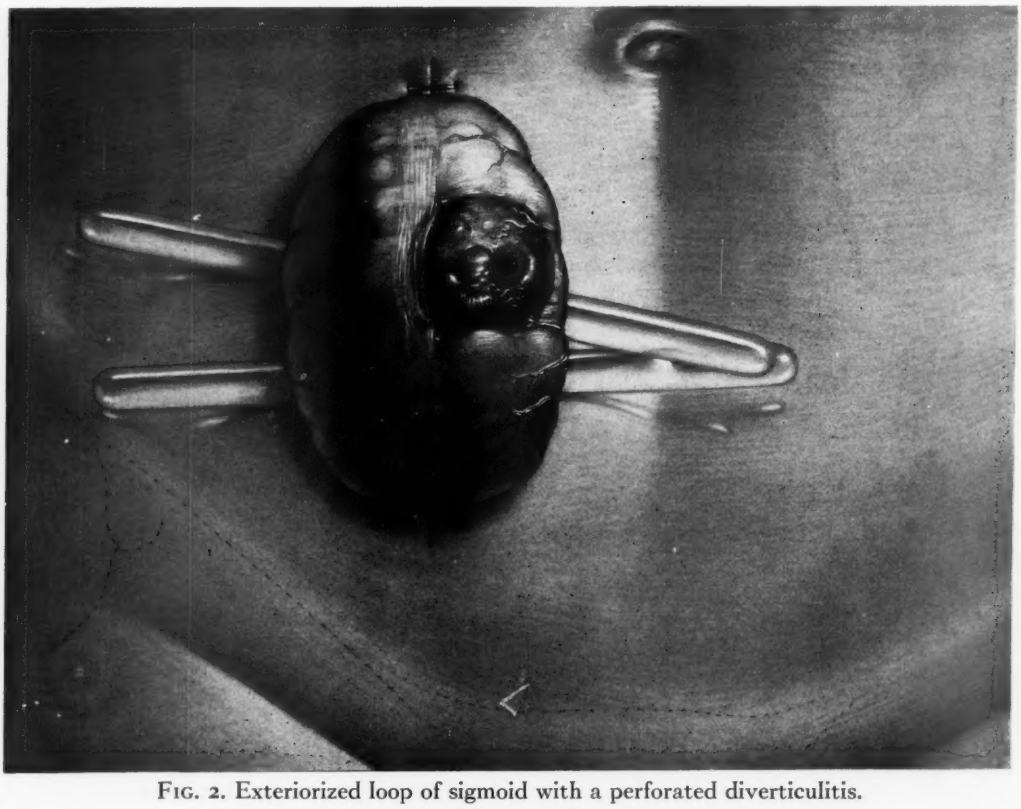

Fig. 2. Exteriorized loop of sigmoid with a perforated diverticulitis.

Case III. A female, age seven, was operated on a provisional diagnosis of acute appendicitis. There was some free serous fluid in the peritoneal cavity. The appendix was found to be but slightly injected and apparently not responsible for the symptoms. A large mesenteric cyst was found near the terminal ileum, which was apparently producing partial intestinal obstruction by angulating the contiguous bowel. The cyst and about six inches of bowel were resected and an end-to-end anastomosis was done. The bowel for about four inches on either side of the anastomotic opening was left outside the abdomen and the wound closed around it. The bowel was kept protected by moist dressings; gastric distention was kept at a minimum by Wangensteen drainage. One thousand cc. of 5 per cent glucose in normal saline was given parenterally or intravenously twice a day. The temperature which was 103°F. on admission fell to normal in a few days. On the third day postoperatively the patient had a spontaneous bowel movement and thereafter had a bowel movement at least once a day. On the eighth day postoperatively the bowel was washed off with saline and reposited within the abdominal cavity which was closed without drainage. The patient made an uneventful recovery and was discharged two weeks later on February 2, 1940.

Case IV. A fourteen year old male was operated upon for acute appendicitis. The appendix was found to be markedly congested and swollen throughout its entire length to about three-fourth inch in diameter. There was also considerable induration of the cecum

around the base of the appendix for a distance of between one-fourth and one-half inch circumferentially. There was a perforation at the base of the mesenteric attachment. The mesoappendix was ligated and the appendix was removed with the portion of the cecum which was indurated, after controlling the fecal current with an intestinal clamp. The cecum was closed by a continuous Connell suture inverting the edges. Because of the induration along the edges, the suture line was not believed to be secure, and the cecum and terminal ileum were exteriorized over a glass rod, and the wound closed with through-and-through silk sutures loosely around the exteriorized bowel. The bowel was protected by moist dressings which were changed daily. On the fourth day after the operation a small area of necrosis at the suture line began to develop, and four days later there was a frank fecal fistula. Bowel movements were regular. Wet dressings were continued in the hope that this fecal fistula would close spontaneously, without success. The induration around the fistulous opening disappeared completely however. On November 12, 1939, the cecum was separated from the abdominal wall and completely mobilized. The edges of the fistula were pared and closed by a Connell suture. This was reinforced by two subsequent layers of sutures and the cecum and terminal ileum were allowed to remain out upon the abdomen and kept protected by moist dressings of saline. The suture line healed and the bowel remained closed. Eight days later the cecum was separated from the abdominal wall and reposited into the peritoneal cavity. At this time a small abscess was found in the lower angle of the original incision which was evacuated. The wound was closed with through-and-through black silk interrupted sutures. The patient developed an infection of the wound, but wet dressings were sufficient to maintain drainage from the suture holes. The sutures were removed on the 9th day postoperatively. The patient was finally discharged on December 20, 1939, cured.

Failure to exteriorize the bowel in this case might have proved fatal if the necrosis had occurred intraperitoneally and the process had not been spontaneously walled off. The secondary closure was successful, however, because by that time the induration was gone.

Case v. A fifty-three year old male was operated upon for acute appendicitis. The appendix was slightly inflamed as though by contiguity. There was a mass in the sigmoid about seven inches above the rectosigmoid junction which was lying in the right lower quadrant of the abdomen. It was red, boggy and had fibrin on the surface, and an epiploic tab was adherent to it as though attempting to wall it off from perforating. The lumen of the sigmoid was almost occluded. The large bowel proximal to the mass was distended as was also the visible small bowel. Apparently the lesion was a diverticulitis of the sigmoid which had not yet perforated and the appendix which was lying very close to it was showing signs of inflammation on the serosa through contiguity. The appendix was removed and the mass was exteriorized over two glass rods through the right rectus incision. The mobility of the sigmoid being such as to allow this to be done easily. The wound was closed around the loop of sigmoid which was then protected by wet dressings. Four days later, spontaneous bowel movement had occurred and daily there was a noticeable decrease in the induration of the bowel wall. By the 7th day the texture of the bowel was normal to the touch. On the 10th day a thin pellicle over the exteriorized bowel was removed by pulling it off and the bowel was sprayed with sulfanilamide powder. On the 12th day the sigmoid which seemed completely restored to the normal was freed from adhesions to the abdominal wall and reposited in the abdominal cavity. There was a slight temperature reaction for a few days and then the patient made an uneventful convalescence. Shortly before repositing the exteriorized loop in the peritoneal cavity a fluoroscopic examination of the exteriorized loop by opaque enema showed that the mixture flowed through the sigmoid without delay. The loop outside the abdominal cavity was readily visualized, but barium passed through this loop much more rapidly then it did through the neighboring portions of the sigmoid, so that at no time was it as well visualized as the proximal or distal loop.

Case vi. A forty-nine year old male was operated upon for perforated diverticulitis of the sigmoid. A perforation of a diverticulum of the sigmoid was found with free pus in the peritoneal cavity. There was considerable induration of the wall of the sigmoid around

the perforation. The sigmoid was exteriorized over a glass rod passed through the mesentery and the peritoneum was drained with one cigarette and one gauze drain and the wound closed loosely around the exteriorized loop and the two drains with through-and-through black silk sutures. The exteriorized bowel was protected with wet dressings. The temperature was 102.4°F., pulse 104, and respirations 28. The bowel discharged fecal material. The temperature remained elevated for twelve days ranging between 103 and 100°F. daily. The drains were removed on the twelfth day postoperatively. By the sixteenth day the temperature had reached normal. On the twentieth day an attempt was made to close the fecal fistula by inverting the edges with two layers of chromic catgut sutures leaving the loop exteriorized, but two days later the fecal fistula redeveloped. During all this time there was a slow but steady recession of the sigmoid into the abdominal cavity. It was deemed worthwhile merely to continue wet dressings to the wound. The fistulous opening gradually became smaller and smaller until on the forty-sixth day postoperatively the fistulous tract was completely closed spontaneously. The sigmoid had retracted into the abdominal cavity so that only approximately one square inch of granulating surface was still uncovered by epithelium, and on the fifty-second day postoperatively the patient was discharged with the wound entirely healed. In this patient no reposition was attempted at any time. He was seen on May 17, 1940, at which time he had an incisional hernia. When this is repaired it will be possible to inspect the retracted bowel wall.

Case VII. A female, aged twenty-one, was operated upon for regional enteritis. Laparotomy disclosed a mass of terminal ileum about two feet in length which was inflamed, thickened, spongy and covered with fibrin. The cecum was also involved. The adjacent mesentery was thickened and contained enlarged glands. In the upper ileum and lower jejunum there was a similar lesion involving about four feet of the bowel. There were about five feet of normal intervening intestines. A resection of the terminal two and one-half feet of ileum, cecum, ascending colon to the middle of the transverse colon and a ileocolostomy was performed in three layers. The anastomosis was exteriorized and covered with wet saline dressings and the wound closed around it. The patient reacted well postoperatively except for severe diarrhea which was finally controlled. On April 20, 1940, the bowel was replaced in the abdomen under spinal anesthesia after thoroughly washing it with saline solution. Convalescence was uneventful except for slight stitch abscesses and severe diarrhea, which caused her to lose about thirty pounds before it was finally controlled by bismuth, vitamin B and thick cereal and gelatin feeding. An *x*-ray of the intestines after barium failed to reveal the lesion in the upper ileum found at operation. She was discharged on May 19, 1940, with the understanding that she would return a month later for treatment of the other intestinal lesion, at which time it will be possible to inspect the reposited anastomosis.

These seven cases are presented as types of lesions in which this operation has been used up to the present time. When the bowel is exteriorized and covered with wet dressings it loses its original appearance within twenty-four hours and the serosa begins to look like granulation tissue. It has a yellowish pink color at first but within a few days takes on a healthy red, slightly bleeding appearance of the kind of granulation tissue one would like to have as a base for a skin graft. In several of our patients in which fistulas developed this granulating surface was contaminated by the fecal current for a good many days. Not only was there no constitutional reaction as a result of absorption from this surface, but apparently the lack of complete sterility at the time that the loop was reposited was not a factor of great importance in determining the character of the convalescence. The question might be raised here as to whether the absorption of infected materials through serous surfaces, which are exteriorized, is different from that of bowel within the peritoneal cavity.

The only opportunity for histologic study of the exteriorized bowel was afforded by a patient who died before the bowel could be replaced.

Case VIII. A male, aged seventy-one, was operated upon for intestinal obstruction by

what appeared to be a carcinoma at the cecum. It was resected removing terminal ileum, cecum, and colon to the middle of the transverse portion. An ileocolostomy was performed and the bowel left outside the peritoneal cavity protected by saline dressings. By the fourth day postoperatively the temperature was normal and a spontaneous bowel movement had occurred, but the abdominal wound began showing signs of breakdown. On the seventh day a leak developed at one point of the anastomosis through which feces was discharged. The abdominal wound broke down completely to the peritoneum and the skin began ulcerating. The ulcerous condition of the skin extended centrifugally quite rapidly and the general condition of the patient became progressively worse so that no attempt was made to close the fecal fistula. Supportive measures failed and he died three and one-half weeks after operation. At autopsy there was no sign of peritonitis or intraperitoneal abscess.

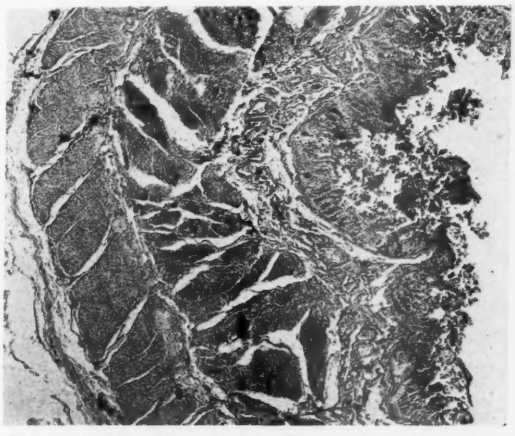

Fig. 3. Microphotograph of a section of anastomosis between ileum and transverse colon on the ileal side which had been bathed in feces for over two weeks. There is a layer of granulation tissue on the serosa.

Figures 3 and 4 represent the microscopic appearance of a section of the anastomosis between the ileum and transverse colon on the ileal side. This had been bathed in feces for over two weeks. The section shows a thickening of the serosa caused mainly by a deposition of granulation tissue. This tissue is infiltrated by a cellular exudate consisting of histiocytes, lymphocytes, polymorphonuclear leucocytes and other forms. There is a deposit of fibrin on the surface which has not yet undergone organization. We have as yet not re-operated upon a patient in whom the exteriorized bowel has been reposited so that we have had no opportunity to see what happens to the bowel after it has been returned into the peritoneal cavity.

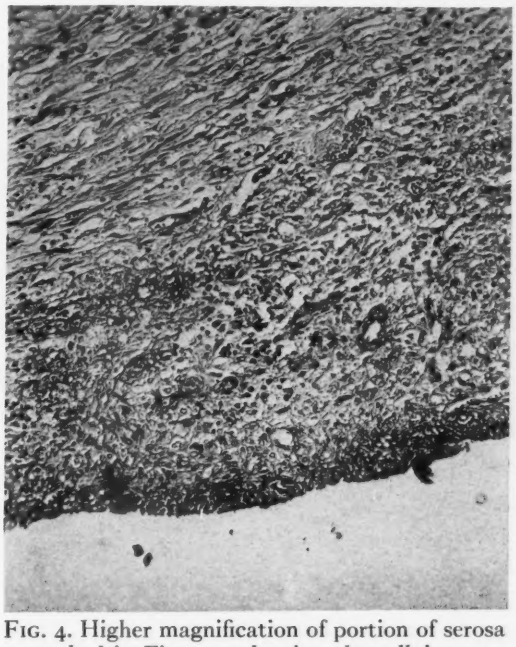

Fig. 4. Higher magnification of portion of serosa marked in Figure 3 showing the cellular exudate. 250 ×.

There have been three complications which we have encountered: The first, injury to the bowel during reposition occurred once (Case 11). The other complications were infection of the wound and hernia. The infection has taken the form of stitch abscesses or an abscess above or below the fascia. The former responded readily to wet dressings and in the latter the wound was opened to establish drainage. In no case has an abscess been found in the peritoneal cavity. It is also of interest to note that no difficulty was encountered with bowel movement despite the abnormal position of the exteriorized loop.

CONCLUSION

Our experience is limited to fourteen cases, ten patients having had resections. Manifestly, leakage into the peritoneum from a questionable point in the bowel

cannot occur when that point is walled off outside the abdominal cavity. Our experience has also indicated that it is not dangerous to reposit an exteriorized loop even after it has been bathed in feces for days, if it is cleansed by thorough washing. This method is, of course, much more troublesome and often involves at least two operative procedures but it does eliminate peritonitis from leakage.

SUMMARY

A new method for diminishing peritonitis from leakage after perforation or resection of exteriorizable bowel is presented. It is based on two propositions: (a) that peritonitis from leakage cannot occur if the leak (actual or potential) is walled off outside the peritoneal cavity, and (b) that it is safe to reposit bowel which has been exteriorized for several weeks after cleansing it with saline solution.

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If the paralysis (in poliomyelitis) is unilateral and localized, there is little or no respiratory distress, but inspection shows that the breathing is weakened on one side. If the paralysis is bilateral, the breathing is mainly diaphragmatic. The examiner should note alternate bulging and retraction of intercostal spaces.

PEPTIC ULCER, HYDROCHLORIC ACID AND EDKINS' THEORY

F. GREGORY CONNELL, M.D.
Attending Surgeon, Mercy and St. Mary's Hospitals
OSHKOSH, WISCONSIN

LOGICAL discussion or rational treatment of peptic ulcer presupposes a familiarity with the following: (1) Normal gastrointestinal physiology; (2) signs and symptoms of abnormal function that justify diagnosis; (3) cause or causative factors, and (4) various types of treatment and indications for each.

Evaluation of various treatments presupposes a familiarity with the natural history of untreated disease and the distinctions between cure and relief of pain or spontaneous remissions.

Physiology of the stomach concerns motor and secretory functions. Tonicity, peristalsis, sphincter action and control of motor activity are complicated and space will not permit a discussion at this time.

Secretory action is probably more important in peptic ulcer. The secretion of the fundus and the antrum differ, the former being acid and the latter alkaline.

The stomach is, embryologically, a double organ; the fundus might be an evagination similar to such structures as the salivary gland, liver and pancreas but differs by not having a narrow duct to transmit secretions.

The practical physiologic problem concerns the three types of stimulation that may cause the fundus to secrete hydrochloric acid, viz., (1) Psychic—vagus, cerebral; (2) gastric—chemical, mechanical contact, tension, gastric hormone; (3) intestinal—amino acids, intestinal hormone. The proper synchronization of these stimuli, balanced by alkaline secreting mucosa, is followed by normal symptomless function; the opposite produces various symptoms.

Diagnosis is, of course, the keystone of treatment. Incorrect diagnosis leads to incorrect and unsatisfactory results. The difference between gastric and duodenal ulcer (because of potential malignancy in the former) is not purely academic. The history of duodenal ulcer is usually quite characteristic, but with such occurrences as typical history with no ulcer (at operation or autopsy) and no history with proven ulcer, mistakes are not uncommon. The diagnosis should be reasonably accurate if it is the result of careful consideration of four factors, viz., the history, which is of most value; the physical examination, which may be of little value; the clinical and *x*-ray laboratory findings, which are definitely helpful.

The cause is unknown, but a common and constant finding is hydrochloric acid. With achlorhydria erosion and other types of ulceration may develop, but peptic ulcer does not occur. Causes of acute ulcerations are known, but why certain abrasions of gastric and duodenal mucosa become chronic and others do not, is still an enigma. Peptic ulcer may be considered as a result of an imbalance between a defensive (alkaline) and an aggressive (hydrochloric acid) factor. The cause of this imbalance is not known and it is probable that there are many causative factors.

The fundamental change might be circulatory, either mechanical that is, quantitative due to cardiac, vascular or nervous changes; or nutritional, that is, qualitative, due to metabolic, anemic, infective endocrine, vitamin or other changes. Such disturbances coupled with local neuromuscular instability might cause abnormal capillary permeability, with consequent interference with nutrition of the stomach wall. The subsequent digestive action of gastric juice creates the typical peptic ulcer. But such an explanation seems

inadequate, when excision with its circulatory disturbance, is followed by satisfactory result.

TREATMENT

Treatment of peptic ulcer is still an unsolved problem, despite many laboratory experiments and clinical experiences with a multitude of new and variously modified old treatments such as: ambulatory medical management and medical management with recumbency and hospitalization; surgical treatment of various types, after failure of medical managements, and more and more radical surgical treatment for so-called intractable ulcer.

These various types of treatment are all based upon the same fundamental objective, that of reducing gastric acidity.

	Nonoperative	Operative plus Nonoperative
After hydrochloric acid secretion	Diet: alkalies, antispasmodics, rapid emptying, aspiration, posture	Excision (local) Pyloroplastics Gastroenterostomy: rapid emptying, regurgitation
Before hydrochloric acid secretion	Diet: fats, salt poor, vitamins Medicine: atropine, bromides Antihormone: histaminase Antisecretagogues: endocrine, enterogastrone, urogastrone	Gastrectomy: distal (antrumectomy) (Edkin's Theory) Gastrectomy: partial: distal and middle (small area of acid secreting fundus) Gastrectomy: subtotal: distal, middle and proximal (larger area of acid secreting fundus) Gastrectomy: proximal (fundusectomy) (still larger area of acid secreting fundus with preservation of distal, alkaline secreting antrum and pyloric sphincter mechanism

NONOPERATIVE TREATMENT

There seems to be an increasing tendency to recognize peptic ulcer as a general disease, with a local lesion, which may be multiple. In consequence there has been an increase in nonoperative treatments, so-called "medical management," based chiefly upon dietotherapy and neutralization which may be roughly divided into: Neutralization of hydrochloric acid *after* secretion (diet, alkalies, rapid emptying, aspiration and antispasmodics), and reduction of secretion of hydrochloric acid (diet, fatty and salt free, antisecretagogues, histaminase, enterogastrone and urogastrone).

A practical antisecretagogue, when developed, will probably solve the question of nonoperative treatment.

OPERATIVE TREATMENT

The chief indications for surgery are complications such as, obstruction, perforation, hemorrhage, malignancy and intractability. Organic stricture is rare and with proper preoperative treatment stenosis will often be relieved. Perforation calls for immediate operation. Early operation in a second hemorrhage is being advocated, but a consensus of opinion has not been reached.

Cancer rarely develops in duodenal ulcer, but it is a strong argument in favor of excision of a gastric ulcer, as a prophylactic measure. Recurrent, or intractable ulcer, especially after previous gastroenterostomy, is a definite indication for surgical treatment.

A distinct trend is away from local excision, pyloroplastics, gastroenterostomy and distal gastrectomy, because of unsatisfactory results; and a contrasting trend is toward proximal gastrectomy, because of more favorable results.

Local resection or excision of the ulcer, of course, in itself does nothing to cure the disease or to remove or counteract the cause. At first it was considered radical, but later was found to be but a palliative measure and its use is now very limited. That resection or excision of the ulcer is not necessary to produce a satisfactory result is shown by the often prolonged improvement following various operations in which the ulcer remains.

Pyloroplastics act chiefly by altering motor function, and indirectly upon secretion by neutralization following reflux of duodenal contents into the stomach. Such operations have not been markedly successful and are being discarded.

Gastroenterostomy is becoming recognized as an unanatomic, unphysiologic procedure that is rarely indicated, except in organic pyloric obstruction. The frequent and increasing sequence of stomal or jejunal ulcer is rapidly discouraging the use of gastroenterostomy.

Distal gastrectomy for duodenal ulcer has been recommended for some years by certain European surgeons, notably Haberer, Finsterer and others, and by Richard Lewisohn in New York and Alfred Strauss in Chicago. Lahey,[11] of Boston, Miller, of Montreal, Reinhoff, of Baltimore, and many others rely more frequently upon distal gastrectomy in the surgical treatment of duodenal ulcer.

The Mayo Clinic's[16] (1938) report shows that surgical treatment for duodenal ulcer is less frequent, and when operation is performed gastroenterostomy is employed less frequently and distal resection more often.

Distal gastrectomy, pyloro-antrumectomy, was based first upon Rodman's[15] theory, i.e., removal of the "ulcer bearing area" which is, in reality, merely an enlarged local excision. This type of operation, at present, is based (consciously or subconsciously) upon Edkin's theory, "Gastric Hormone."[7]

This theory, presented in 1906, briefly stated that "The antral mucosa secretes a hormone (gastrin) that, when carried in the blood stream to the fundus of the stomach, stimulates the parietal cells to secrete hydrochloric acid."

Edkins thought that early gastric digestion might lead to the formation of substances which had particular influence in the development of certain gastric secretions. He noted that, "Extracts of *pyloric* mucous membrane contain an active substance when injected into blood vessels, which leads to secretion of gastric juice." (hydrochloric acid.) No study of duodenal mucous membrane was made. This theory is not new (1906) and has not as yet been accepted by either physiologists or clinicians.

Most physiologists consider the so-called gastric hormone, gastrin, to be histamine or a histamine-like substance, an end product of protein digestion, or an amino acid that may be found in the duodenum as well as in the antrum. The similarity in structure of the antral glands and Brunner's glands of the duodenum, helps such a supposition. Their chief difference is in the location relative to the submucosa.

Experiments of various types and clinical reports by Smidt (quoted by Finsterer[8]) E. B. Lewis,[12] J. H. Grindley[10] and O. H. Wangensteen[17] do not confirm Edkins' theory. Even if this theory is correct, the influence of antral resection upon fundal secretion might not be noteworthy because of the remaining two types of gastric stimuli (psychic and intestinal).

Clinically, after removal of the pylorus and antrum and reestablishment of the gastrointestinal continuity by gastrojejunostomy, it is difficult to determine how much reduction in gastric acidity is due to neutralization by reflux of duodenojejunal secretion. Practically, distal gastrectomy has failed to reduce acidity satisfactorily and recurrences have gradually led to the additional removal of more and more of the proximal portion of the stomach with more and more of the acid secreting fundus.

Granting the correctness of Edkins' theory, and presuming the objective of treatment to be diminution of hydrochloric acid secretion, and accepting the three physiologic types of stimulating hydrochloric acid secretion, it would seem that removal of, or interference with part of the second stimulant, while the others remain active, would not greatly reduce the secretion of hydrochloric acid.

Certain distinct disadvantages may follow distal gastrectomy, the chief of which is removal of the pyloric sphincter which normally separates the acid stomach contents from the alkaline duodenal contents.

This complicated, delicately balanced and synchronized antropyloro-duodeno-neuro-muscular mechanism cannot be reestablished by any artificial gastrointestinal communication and its destruction

constitutes a serious mutilation. The normal duodenum is the source of many secretions and hormones (secretin, cholecystokinin, enterogastrone and perhaps others) with important physiologic functions, and the first step in their liberation is due to the arrival of acid gastric contents into the duodenum.

Another reason for retaining the distal stomach, when possible, is the suggestion of Meulengracht[13] that the "intrinsic factor" of Castle, the anti anemic substance, may originate in the pyloric glands as well as in the duodenal Brunner's glands.

Physiologically and clinically, it would seem that removal of the antrum is not absolutely necessary in surgical attempts to reduce gastric acidity. Persistance of hyperacidity and recurrent peptic ulcer after removal of the antrum speak so strongly against the theory that the present trend is to be seen in the development of proximal gastrectomies, i.e., operations which remove more and more of the fundal acid secreting mucous membrane. This "*shift to the left*"[1] from alkaline to acid secreting portions of the stomach is well shown in the gradual evolution from antrumectomy (distal) through partial gastrectomy (distal and proximal) to subtotal gastrectomy (distal and more proximal).

Subtotal gastrectomy has improved results, but produced serious physiologic faults, viz., loss of sphincter action at gastrointestinal anastomosis and diminution of alkaline gastric secretion.

The next step in the surgical treatment of duodenal ulcer would seem to be proximal gastrectomy, with retention of the distal alkaline secreting portion of the stomach and of the pyloric sphincter. This procedure was suggested by the author in 1929.[4,5] In 1940, Wangensteen[17] published a "Preliminary description of subtotal excision of the acid secreting area for ulcer" and Zollinger[18] emphasized removal of the fundus. In 1941, Friedell[9] discussed this aspect of the subject.

Personal clinical experience with proximal gastrectomy, that is, partial fundusectomy in conjunction with dietotherapy, have recently been published.[2,3]

The total number of such cases is now twenty-five; the newer ones are too recent to justify a consideration of the remote results, but the first, an intractable case, with two previous perforations was operated upon in December 1931[6] and despite many unfavorable factors, continues to be entirely free from gastric symptoms.

An attempt to evaluate the result of treatment is difficult. Before doing so, one must be familiar with the life history of *untreated* peptic ulcer which is characterized by sudden spontaneous remissions, often of many years duration. Cure of disease must be differentiated from relief of pain and from spontaneous remissions.

Knowledge of the fact that symptoms may exist without an ulcer being present and that ulcers, ready to bleed or to perforate, may produce no symptoms, should cause one to hesitate before considering a given case as cured.

For example, I was called by an associate to see the splendid eight year postoperative result of an operation for perforated peptic ulcer. In my interview with the patient he was asked about his symptoms *before* the perforation. In reply he stated that he had experienced no gastric symptoms before the severe pain that immediately preceded his operation and that he had had no symptoms since. In view of this history I asked why he might not have another perforation tonight. About three months later I again saw this patient in the hospital after an emergency operation for a second acute perforation.

On the other hand, one must remember that return of symptoms such as hemetemesis, melena or "indigestion" does not necessarily mean return of peptic ulcer, but may be due to the developing of other pathological condition, such as cirrhosis of the liver, gastritis or hemorrhoids.

Thirteen years ago I performed an exclusion operation for a large duodenal ulcer in which the chief symptom was

melena. The patient was told that the ulcer remained and that he might have a recurrence and if so he was to return at once for further treatment. About one year later the patient presented himself much discouraged and reconciled to the idea of another operation. But rectal examination revealed a very large bleeding hemorrhoid. Proper treatment of this hemorrhoid has been followed by no bleeding and an entirely satisfactory result.

Indigestion, dyspepsia, gas, etc., may be due to a multitude of intra- or extraperitoneal diseases other than a recurrent peptic ulcer.

Seemingly permanent cures, spontaneous remissions, after evidently inadequate medical management or theoretically insufficient surgical treatments, and on the other hand, recurrences after repeated theoretically competent surgical operations, make a proper evaluation of treatment difficult and statistics misleading.

CONCLUSIONS

1. Physiologically the stomach may be divided into an acid secreting fundus and an alkaline secreting antrum.

2. Hypersecretion of hydrochloric acid is a constant finding in peptic ulcer.

3. Secretion of hydrochloric acid is due to psychic, gastric and intestinal stimuli.

4. Treatment aims to reduce hyperacidity by neutralization after secretion, or by diminishing secretion.

5. Results after "medical management" in the uncomplicated cases of duodenal ulcer are quite satisfactory.

6. Complicated or intractable cases are usually treated by surgical measures, gastric resection.

7. Edkins' theory presumes that an antral hormone, gastrin, stimulates fundic acid secretion.

8. This theory is the basis for distal resection of the stomach in the treatment of duodenal ulcer.

9. This theory has not been proved either experimentally or clinically.

10. Unsatisfactory results after pylorectomy, antrumectomy and partial gastrectomy have resulted in attempts at improvement by the removal of more and more of the proximal acid secreting stomach, i.e., subtotal resection.

11. It is suggested that subtotal resection be modified by preservation of the alkaline secreting antrum and the pyloric neuromuscular sphincter mechanism.

12. Because of various unknown factors it is wise to refrain from drawing conclusions relative to results of treatments until after the elapse of at least five years.

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PRIMARY LIVER CELL CARCINOMA

ANGELO M. GNASSI, M.D.
Director of Laboratories, Medical Center
JERSEY CITY, NEW JERSEY

IN a survey of 2,870 surgical and postmortem malignant tumors, we encountered only four cases of primary liver cell carcinoma. We deem it worthwhile to report these four cases.

CASE REPORTS

CASE I. Mrs. B. F., a thirty-four year old housewife, entered the hospital on July 12, 1937, complaining of sharp pain in the upper right quadrant.

Her history dates back to four weeks previous, when she experienced a similar attack which lasted several hours. At that time there was no nausea or vomiting and after several hours the pain subsided to a dull ache radiating to the right axillary and subscapular regions. Two weeks before admission she was nauseated and vomited several times. On July 10, the acute symptoms recurred and two days later she entered the hospital. During the present illness there had been marked anorexia, moderate diarrhea, and a weight loss of twelve pounds. There had never been any jaundice, chill, hematemesis, tarry or clay-colored stools. The family and past histories were essentially negative.

Physical examination revealed a fairly well developed and fairly well nourished negress who did not appear acutely ill. The temperature was 99.6°F., the pulse 84, respiration 20, and the blood pressure 110/80. There was an internal strabismus. The ears, nose and throat were essentially normal, and there were no palpable lymph-nodes. The lungs were clear and resonant with the right diaphragm somewhat elevated. The heart was normal. There was moderate tenderness and muscle spasm in the right upper quadrant of the abdomen, and beneath the right costal margin was felt a soft mass, 10 cm. in diameter, which was smooth, nonmovable and tender, and seemed to be attached to the liver. Neither the liver edge nor the spleen were felt. The remainder of the examination was normal.

The urine was normal. The hemoglobin was 90 per cent (Tallqvist): there were 4.40 million red blood cells and 8,500 white blood cells with 70 per cent polymorphonuclears. The blood Wassermann and the spinal fluid Wassermann tests were negative. The icteric index was 7, and the Van den Bergh test negative. The blood sugar was 76 mg. per cent and the NPN 27 mg. per cent. The glucose tolerance test showed the fasting specimen to be 82 mg., and the subsequent half-hourly specimens 92.5, 135, 168, and 156 mg. per cent. A flat film of the abdomen and a chest film were normal. After the Graham test the gallbladder was not seen.

Her treatment consisted of clysis of 1,500 cc. of 2.5 per cent glucose in normal saline. One week later she was given fluids by mouth which were gradually increased to a soft diet. Two weeks after admission, she was given a 500 cc. blood transfusion. On August 3, an exploratory laparotomy was performed by Dr. E. Burke. His operative note states "Within the right lobe of the liver was a grapefruit-sized mass which pressed out against the anterior abdominal wall but was not adherent. Its wall, anteriorly consisted of a paper thin shell of hepatic tissue of extreme friability. Inadvertently, this thin covering was perforated which resulted in profuse hemorrhage. From the interior of the tumor, masses of pulpy material were discharged which looked exactly like bloody scrambled eggs." A biopsy was submitted to the laboratory and the pathological report was primary liver cell carcinoma.

Postoperatively, she reacted poorly and remained in a comatose state. She received intravenous glucose in amounts from 100 to 175 Gm. daily. Her temperature ranged from 99.6 to 101°F. The patient expired October 6, 1937. The total duration from the time of the first symptom was five months. Autopsy was not obtained.

CASE II. Mr. F. M., a sixty-six year old male complaining of dyspnea, was admitted to the hospital July 7, 1939, by request of a local physician with the diagnosis of hypertrophic cirrhosis. He had remained in good health until January when he noted shortness of

breath on exertion, followed by edema of the ankles, nocturia and a productive cough. Two weeks of rest in bed and medication, as prescribed by his doctor, restored his health. About five weeks ago he began to notice he was quite constipated and had pain in the lower portion of the abdomen when his bowels did not move for several days. Occasionally, he had epigastric pain after meals, but he was never nauseated nor vomited. Three weeks before admission shortness of breath appeared and a productive cough, and three days before admission he noted sharp pain in the right side of the chest aggravated by breathing. The respiratory distress increased and his admission was advised. There had been a twenty pound weight loss during the previous five weeks.

The patient's mother had died at forty-six years of age with "consumption" and his father had died at forty-two years of age with the same disease. One sibling was living and well. His wife and one child were living and well. When seventeen years of age, the patient had typhoid fever, at twenty years he had a penile ulceration which was never treated, and at forty-five he had bronchitis.

On physical examination, the patient was an emaciated, white male who looked chronically ill, was in respiratory distress, and showed evidence of recent weight loss. There was moderate pitting edema of the ankles. His temperature was 101.4°F., pulse 90, and respiration 30. The nasal septum had a large clean perforation. The throat was diffusely injected and the tongue red and smooth with atrophic papillae. The heart was essentially normal and the blood pressures 144/68. The chest was hyperresonant except for slight dullness in the right apex, with crackling râles and bronchovesicular breath sounds. The abdomen had prominent superficial veins. A firm, smooth, tender liver edge was felt at the iliac crest. The remainder of the examination was essentially negative.

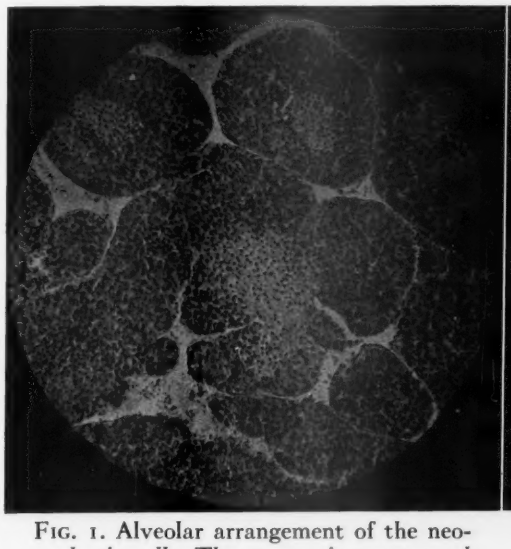

Fig. 1. Alveolar arrangement of the neoplastic cells. The stroma is scanty and vascular.

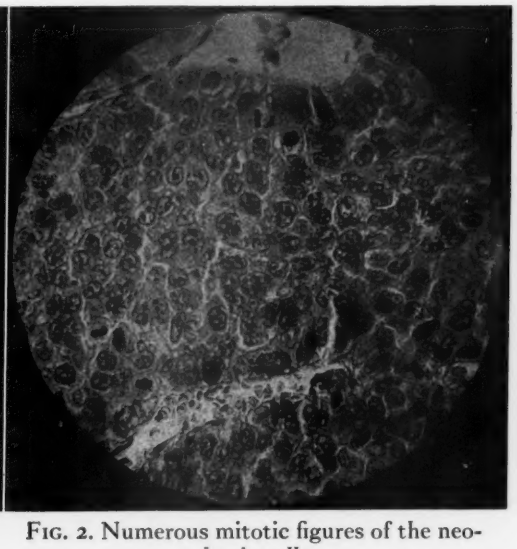

Fig. 2. Numerous mitotic figures of the neoplastic cells.

The urine was normal. There were 70 per cent hemoglobin by Tallqvist, 3,820,000 red cells and 5,900 white cells per c. mm. with 69 per cent polymorphonuclear leucocytes. Blood sugar was 87 mg. per cent, and nonprotein nitrogen 36 mg. per cent. Icteric index was 7.4 and a Wassermann test was negative. Gastric analysis showed no free acid after a test meal and no occult blood present. A gastrointestinal series was essentially normal, except for displacement of the stomach and colon to the left by the large liver.

During his hospital stay, the temperature ranged from 98.6 to 100.6°F., epigastric pain remained fairly severe and the liver increased in size. He was given 50 cc. of 50 per cent glucose intravenously daily and 1 cc. of saturated solution of potassium iodide three times a day. However, he grew progressively weaker and on the twenty-sixth hospital day developed a chill. His temperature remained around 103°F. and he died on the twenty-ninth hospital day. The total duration of the disease from the onset of symptoms was eight months.

The relevant postmortem findings were as follows: Both lungs were studded with many metastatic nodules varying from 0.5 to 1.5 cm.

in size, which, on section, were yellowish brown and firm. The liver weighed 2,200 Gm. Its surface was reddish brown and nodular; an

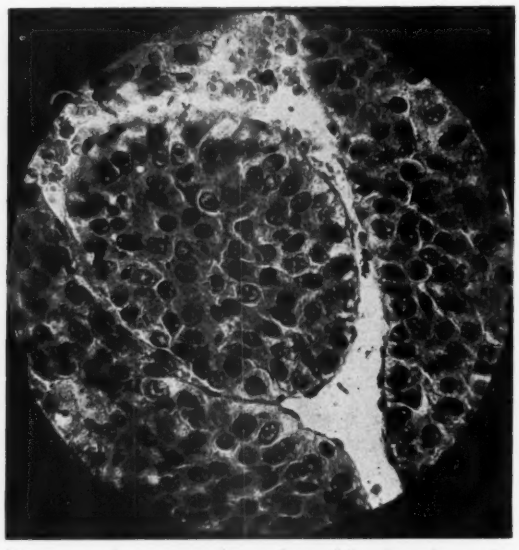

Fig. 3. Anastomosing sinusoids forming the supporting tissue of the neoplasm.

18 cm. soft nodule extended downward from the left lobe. The cut section revealed a poorly circumscribed mass occupying most of the right lobe, a similar mass filling the quadrate lobe, and a large mass in the left lobe continuous with the tumor projecting from its lower surface. Each of these masses was soft, friable, red, and some had yellowish necrotic centers. No neoplasm was demonstrable in the portal vessels. Microscopical diagnosis was primary liver cell carcinoma with pulmonary metastases.

Case III. Mr. R. G., a fifty-six year old machinist, was admitted to the hospital on September 22, 1938, complaining of lower abdominal pain of three weeks duration. He had been in fairly good health until Labor day when he noted intermittent coliky pain lasting one to fifteen minutes which usually occurred after eating. His stools became small in caliber, and during the last two weeks he was markedly constipated. The lower part of the abdomen progressively increased in size, and during the past few days anorexia became quite marked, but there was no nausea or vomiting.

He had had the usual childhood diseases. In November, 1935, the patient was admitted to the Medical Center complaining of left upper quadrant pain; after observation for one week the pain subsided and he was discharged. In February, 1936, the patient was hospitalized again for removal of a ruptured appendix and discharged thirty days later. In October, 1936, he was readmitted for intestinal obstruction and he was operated upon with the following findings: "There was an adhesive band completely constricting the lumen of the ileum, approximately 15 cm. from the ileocecal valve. The band extended from the mesentery of a loop and was attached to the serosa of an adjacent loop, causing a complete constriction of the intervening ileum. The terminal portion of the ileum was also tightly tied down, posteriorly by adhesions." Otherwise the abdominal cavity was free of pathological changes. On November 28, 1936, he was discharged from the hospital feeling well.

The family history was noncontributory. During the past five years he experienced infrequent precordial pain of two minutes duration, dyspnea on exertion and nocturia.

Physical examination revealed a fairly well developed and nourished white male, mentally alert and not acutely ill. The temperature was 98.8°F., pulse 88, respiration 20, and blood pressures 140/80. The right pupil was slightly larger than the left and irregular, but both reacted to light and accommodation. The sclerae were clear. The ears, nose and throat were essentially normal and there were no palpable lymph-nodes. The right diaphragm was slightly elevated, but otherwise the chest was clear and resonant. The heart was slightly enlarged to the left, the rhythm regular and sounds of poor quality without murmurs. The abdomen had well healed right rectus and midline suprapubic scars. The lower abdomen was distended and shifting dullness and a fluid wave were present. The liver edge was felt 6 cm. below the right costal margin, and it was firm, smooth and slightly tender. The spleen was not felt. A rectal examination was essentially negative and the extremities were normal except for marked varicosities of both lower legs.

The urine was normal. The hemoglobin was 80 per cent by Tallqvist, there were 4.82 million red blood cells and 12,000 white cells with 74 per cent polymorphonuclear leucocytes. The Wassermann test was negative. The blood sugar was 99 mg. per cent, and the nonprotein nitrogen 25 mg. per cent. The icteric index was 14, and the Van den Bergh test was negative. A chest film showed a small, well healed productive lesion in the right apex; a barium enema and a gastrointestinal series were essentially normal. Three weeks after admis-

sion there was no urinary sugar after a galactose tolerance test; the icteric index was 20 and the blood nonprotein nitrogen was 40.

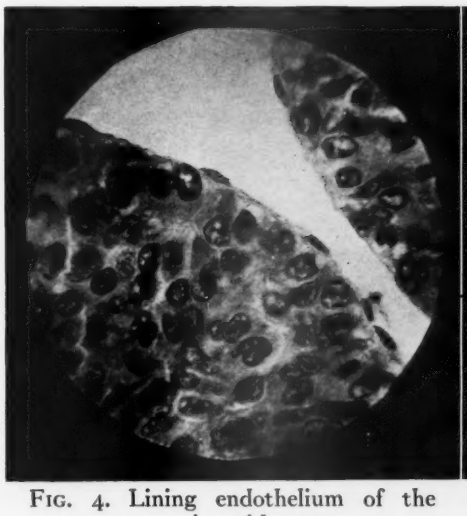

Fig. 4. Lining endothelium of the sinusoids.

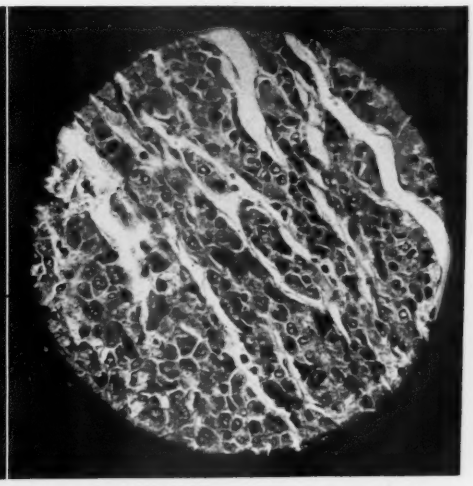

Fig. 5. Cord-like arrangement of the neoplasm.

The treatment was symptomatic. After several large enemas the bowels became regular and a soft diet was taken well. Paracentesis on the day following admission yielded only 20 cc. of a straw-colored fluid; on the twelfth day 1,700 cc., on the eighteenth day 1,300 cc., on the twenty-second day 2,000 cc., and on the forty-second day 1,900 cc. of straw-colored fluid. Medication consisted of brewer's yeast, sweetened drinks, 100 Gm. of intravenous glucose daily, and codeine phosphate for pain. The patient became steadily weaker, lost his appetite, started to vomit frequently on the fifty-third day, and on the fifty-fifth day he bled a little from the mouth and died shortly thereafter. The total duration of the disease from the onset of the first symptom was three months.

Permission was obtained for an autopsy limited to the abdomen. The liver weighed 2,500 Gm. Its surface was green and studded with numerous light, elevated, 1 to 2 cm. nodules. On section there were many discrete round, firm grayish, granular massse varying from 1 to 4 cm. in diameter which were evenly distributed throughout all lobes. The gall-bladder, bile ducts, pancreas, and local lymph-nodes, were grossly normal. Microscopical examination of the liver revealed primary liver cell carcinoma.

Case iv. Mr. P. A., a seventy-seven year old white male, entered the hospital on May 29, 1939, complaining of abdominal pain of one month's duration. He had been in fairly good health until four weeks previous when he noted a dull, persistent epigastric pain which radiated laterally into the left flank and persisted until admission. One week later his appetite became poor. There had been no nausea or vomiting, diarrhea or constipation, jaundice, bloody or clay colored stools.

The family history was essentially negative except that his wife died of pulmonary tuberculosis at thirty-five years of age. Fifty years ago he had gonorrhea and one year later a penile chancre which was never treated. During the past four years he had noted pain in the lower back and nocturia. During the past year there had been some loss of strength and an estimated weight loss of fifty pounds. He had never been a heavy drinker of alcohol.

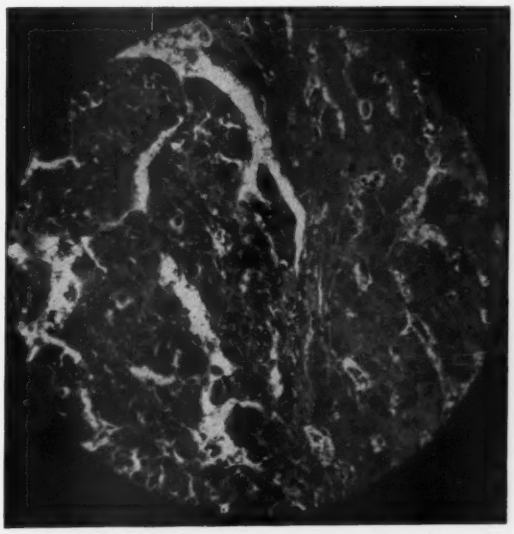

Fig. 6. Inconspicuous stroma separating the tumor from the parenchyma of the liver.

Physical examination revealed a fairly well developed and nourished white male, mentally

alert and in no acute distress. The temperature was 98.8°F., pulse 88, respiration 20, and blood pressure 160/80. The skin of the trunk, arms,

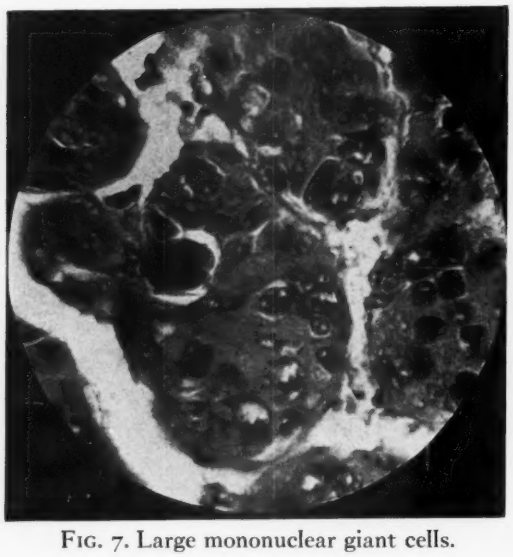

Fig. 7. Large mononuclear giant cells.

and legs had scratch marks and a maculopapular eruption. There was a faint icterus of the sclerae. The ears, nose and throat were normal and there were no palpable lymphnodes. The chest was clear and resonant, and the heart was essentially normal. The abdomen was moderately distended. There was tenderness in the left upper quadrant and in the left costovertebral angle. In the epigastrium was a nontender, firm, fixed mass measuring about 6 cm. in diameter. The remainder of the examination was essentially normal.

The urine was essentially normal. The hemoglobin was 80 per cent by Tallqvist, the red cell count 4.27 million, and the white cell count 11,400 with 73 per cent polymorphonuclear leucocytes. The fasting blood sugar was 116 mg. per cent. A flat film of the abdomen was within normal limits.

After admission he rested quietly, although the abdominal pain continued. The following day he suddenly fell into coma, became cyanotic and the respirations became irregular. In spite of stimulants he died quietly on the third hospital day, one month after the onset of the first sympton.

Postmortem examination revealed two liters of slightly turbid, yellowish peritoneal fluid. The liver weighed 1,750 Gm. Its surface was brownish gray in color and presented numerous nodules. On cut section, there were many poorly encapsulated 3 to 10 cm. masses of soft, friable, red or yellowish tissue. The largest mass was located in the left lobe near the falciform ligament. Microscopical section of the tumor showed typical liver cell carcinoma.

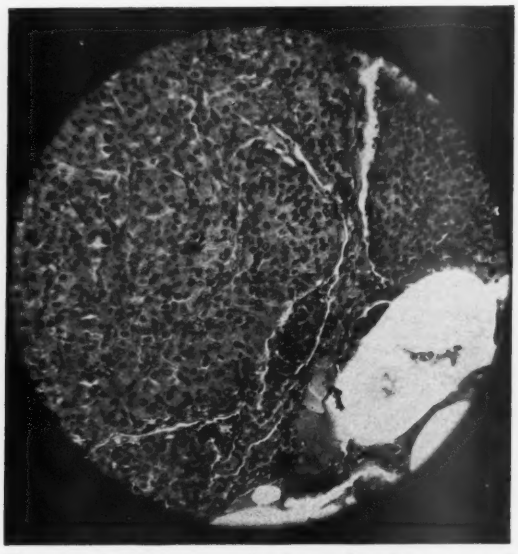

Fig. 8. Metastasis to the lung showing areas of emphysema.

Pathological Observations. Microscopically, each of the livers showed closely related alveoli (Fig. 1) separated by sinusoids. The cells were acidophilic, polygonal, with one or two nuclei which were frequently in a state of mitosis. (Fig. 2.) The sinusoids anastomose (Fig. 3) and are partially lined with a single layer of endothelial cells. (Fig. 4.) The cells in places have a cord-like arrangement, but the stroma is chiefly composed of capillaries. (Fig. 5.) A scanty amount of stroma separates the tumor from the liver parenchyma. (Fig. 6.) Occasionally large mononuclear giant cells are seen. (Fig. 7.) Within the lung the cellular characteristics are maintained and here the lobules are similarly separated by capillaries partially lined with a single layer of endothelium. (Fig. 8.)

CONCLUSIONS

1. Carcinoma of the liver still is a rare tumor. It represents 0.14 per cent of our malignancies.

2. The microscopical diagnosis in the vast majority of cases is not difficult.

3. The varieties of symptoms and absence of a palpable mass render the clinical diagnosis extremely difficult.

4. The duration of the disease in our series, once the symptoms manifest themselves, is five months.

ENDOMETRIOSIS OF SIGMOID AS A CAUSE OF ACUTE INTESTINAL OBSTRUCTION*

CHARLES L. PATTON, M.D., F.A.C.S. AND ROBERT J. PATTON, M.D.
Attending Surgeon, Springfield and St. John's Hospitals
Associate Surgeon, Springfield Hospital; Attending Surgeon, St. John's Hospital
SPRINGFIELD, ILLINOIS

INASMUCH as the bowel is occasionally seriously invaded by aberrant endometrial tissue and a characteristic syndrome is often produced thereby, it is advisable for the surgeon to be aware of the possibility and become familiar with the symptomatology.

Rokitansky is credited with the earliest description of adenomyoma of the uterus in 1860.[17] A variety of extra-uterine endometriomas (adenomyomas) were described by Cullen,[10] and he emphasized the frequent involvement of the rectum via the rectovaginal septum. Spencer,[37] in 1913, first described endometriosis of the sigmoid, and since that time isolated case reports[3,5,10,26,27,30,35,38] and a few series[8,20,23] of such cases have been published. A minor proportion of the cases have had obstructive symptoms.[4,8,13,15,19,20,31] The preoperative diagnosis of endometriosis as the cause of acute obstruction of the sigmoid is rarely made.

PATHOLOGY

A localized area of endometrium-like tissue bearing characteristic glands, stroma and, occasionally, smooth muscle, and thriving in an unnatural site is an endometrioma, according to Blair-Bell;[6] diffuse or multiple areas constitute endometriosis; however, the terms are loosely interchanged. The cyclic and progressive recurrence of a clinical syndrome induced by the physiologic, menstrual-like changes occurring in this aberrant and invasive, but almost universally benign tissue provides the chief diagnostic features of the disease. Thomson[39] reported malignant degeneration of the muscle elements of a rectovaginal "adenomyoma" with fatal pulmonary metastases. No report of the development of cancer in an endometrioma of the sigmoid has been found. In the sigmoid, involvement of the serosal and muscular layers is usual, and atrophy of the mucosa without invasion by the underlying endometrial tissue is commonly found. Any degree of stricture may be produced, and the endometrioma may project into the lumen as a polyp; intussusception may be produced thereby. Characteristically, the serosa is puckered over the lesion and the gross appearance by inspection and palpation is almost indistinguishable from carcinoma. No mesenteric lymphadenopathy is associated with endometriomas, however.

Though many theories have been propounded to explain the origin of endometriosis, two or three are now generally debated. Sampson's[33,34] attractive theory proposes that endometrium, shed from the uterine canal at the time of the menstrual period, is forced in retrograde direction through the fimbria of the Fallopian tube and becomes implanted on the peritoneum, usually where there is a fold or niche in the serosa. Another theory, that Muellerian or Wolffian cell rests are stimulated to proliferation in adult life, is less commonly accepted now. A third, and popular theory[29] concerns an inflammatory irritation of pluripotential serosal cells provoking metaplasia or dedifferentiation to endometrium-like tissue. Allen[2] has experimental evidence suggesting that such cells may be stimulated by glandular dysfunction.

* From Springfield Hospital, Springfield, Illinois.

INCIDENCE

Endometriosis of the various reproductive organs is now recognized as a relatively common disease. In 1,000 gynecological surgical cases Green-Armytage[15] found endometriosis in 8.9 per cent. Cullen[10] noted involvement of the rectovaginal septum frequently, but the incidence was lower in Masson's series.[23] With decreasing frequency (and decreasing proximity to the uterus) are found endometriomas of the sigmoid, abdominal wall and umbilicus, ileum and appendix. The bladder and vaginal wall are involved in a similarly small percentage of cases. In a series of 576 patients with 689 organs involved, Masson found fourteen cases (2.4 per cent) with involvement of the sigmoid, while similar involvement was found in four (or 3.8 per cent) of 104 cases of endometriosis at the Lahey Clinic by Cattell.[8] Varying degrees of obstruction are reported, but acute obstruction due to sigmoidal endometriosis is apparently uncommon.

DIAGNOSIS

The symptoms of endometriosis of the sigmoid were extensively reviewed by Mayo and Miller;[24] they vary little from the syndrome of pelvic endometriosis.[16,28] The disease occurs only in the female and generally in an otherwise healthy woman in the years of active menstruation, although a few cases are recognized after the climacteric.[2,25] Progressive acquired dysmenorrhea is almost constant. Many have menstrual irregularities, metrorrhagia and menorrhagia. Dyspareunia and sterility are frequent complaints. Pain on defecation or examination of the rectum is common, and there is often comenstrual constipation with a low incidence of occult or gross blood in the stools. The sigmoidoscopic examination may be limited by pain or abrupt angulation of the bowel, and, though an extrinsic mass may be suspected, there is rarely a detectable mucosal lesion. A barium enema may reveal a filling defect with normal mucosal pattern,[11,19] as in our case. Accentuation of the presenting symptoms at the time of the menses is the constant diagnostic feature.

Physical examination often reveals tender tubo-ovarian masses, cysts, rectovaginal nodules, or other evidence of pelvic endometriosis. Abdominal palpation is usually disappointing. Glandular hyperplasia of Swiss cheese type is commonly found by uterine curettage,[2] and a high incidence of fibroids has been noted.[2,32]

TREATMENT

In most cases, endometrioma of the sigmoid is found incidentally during a laparotomy for pelvic endometriosis with which it is so commonly associated. Should the degree of pelvic involvement indicate removal of the ovaries (and the body of the uterus, in the opinion of most writers), subsidence of the sigmoid lesion may be expected if the involvement is not too extensive. Small discrete endometriomas of the bowel may be eradicated by cautery or resected when oophorectomy is not contemplated, and the bowel wall may be sutured transversely to prevent stricture as suggested by Maclean.[22]

Large endometriomas of the sigmoid, especially those producing obstruction by narrowing or intussusception, may require resection and end-to-end anastomosis, more properly performed after diversion of the fecal stream by colostomy. The majority of cases reported have been treated in a manner similar to this.

However, we have noted several reports of recession of large sigmoidal endometriomas following castration alone, or colostomy and castration in obstructed cases. Cattell reported one case of rectovaginal and sigmoidal endometriosis in which, sixteen months after castration, the sigmoid showed no lesion by *x*-ray. Hutchins,[18] Eggers,[12] Miles,[26] Stetson and Moran,[38] McKittrick,[25] Pemberton[32] and others have had cases with severe sigmoidal involvement which appeared to regress with castration. We have found no report of subsequent laparotomy or necropsy on any patient who had an obstructing sigmoidal

endometrioma treated by castration alone. Pathological study of such a case would be of major interest.

Irradiation castration has some proponents.[1,21,22] Opponents[10,36] of this therapy conclude that: (1) total and permanent castration is not certain, (2) irradiation may activate a dormant pelvic inflammation, (3) simple and endometrial ovarian cysts are commonly associated with endometriosis of the pelvis or bowel and require surgical removal, and (4) because carcinoma can be definitely excluded only by microscopic examination in many cases, exposure for biopsy must be considered advisable.

Preservation of ovarian function, when possible, in women of childbearing age, by resection of all involved tissue without castration is advised. At the Mayo Clinic,[9] of five patients with endometriosis who had multiple, thin, ovarian transplants in the abdominal wall after castration, four had no ensuing symptoms of ovarian insufficiency nor of the original disease.

CASE HISTORY

L. M., a housewife, age forty-two, entered Springfield Hospital July 5, 1940, complaining of obstipation of six days' duration and vomiting which began on the day of admission. Her last bowel movement was pencil-like and without blood occurring at the termination of a three day menstrual period characterized by profuse flow and more than usual cramping.

Four years before entry she was treated for incomplete abortion of a two months' conception. At that time she remarked intermittent, but not recent attacks of right upper quadrant pain radiating to the back, unaccompanied by jaundice and relieved only by opiates. The symptoms subsided, and the patient lost twenty-five pounds following dietary regulation.

Six months before the present admission she re-entered because of left-sided and upper abdominal pain of two months' duration. Sigmoidoscopic examination was limited by pain but no abnormality was detected in the distal 15 cm. Subsequent fluoroscopic visualization of barium enema, repeated once, was reported, "localized spasm of sigmoid as commonly seen after sigmoidoscopy." Three of four stool examinations (general diet) were positive by benzidine test. Cholecystograms revealed poor function and numerous negative shadows

Fig. 1. Air contrast enema demonstrating filling defect in high sigmoid with preservation of mucosal pattern suggesting extrinsic involvement.

suggesting calculi. Cholecystectomy was performed January 8, 1940; the gallbladder contained about fifty mixed pigment and cholesterol stones; in routine exploration no abnormality of bowel or pelvis was recognized.

The patient's menstrual periods began at the age of thirteen occurring regularly every twenty-eight days and lasting five or six days with minimal headache and fleeting pelvic distress until about two months before the present admission when cramps became more severe, but never incapacitating, and the flow became more profuse with occasional clots. During a similar interval mild comenstrual constipation without bleeding was noted. The period immediately prior to the onset of obstruction was the most severe she had experienced.

She was first married at the age of twenty-five; one pregnancy resulted with a living child. Her second marriage took place at the age of twenty-nine; one pregnancy occurred, aborting at two months (v.s.). Deep dyspareunia was present without bleeding for ten years prior to admission.

Physical examination revealed temperature 100.4°F., pulse 90, respirations 50. She was a well nourished, restless female with flushed

face and grunting respirations; skin not dry; tongue coated but moist; chest resonant; breath sounds clear; diaphragms raised. The bowel and distended colon. A loop of sigmoid colon was fixed to the left uterine adnexae by a 5 cm. mass involving both structures and

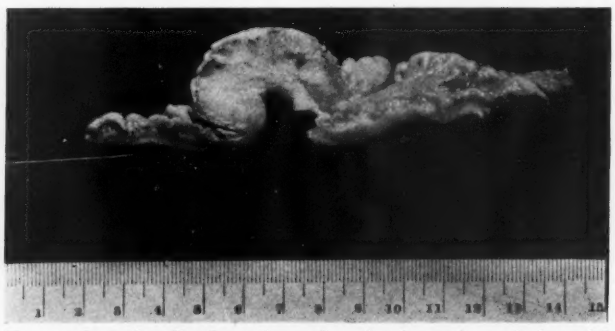

FIG. 2. Longitudinal section of excised portion of sigmoid showing puckering of serosa and intraluminal protrusion of endometrioma without ulceration. Mucosal surface is uppermost in photograph.

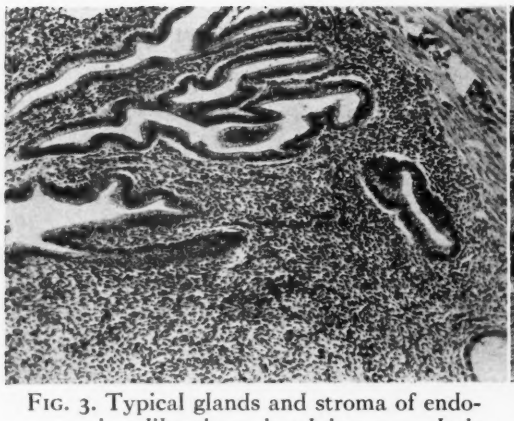

FIG. 3. Typical glands and stroma of endometrium-like tissue involving muscularis of sigmoid. × 70.

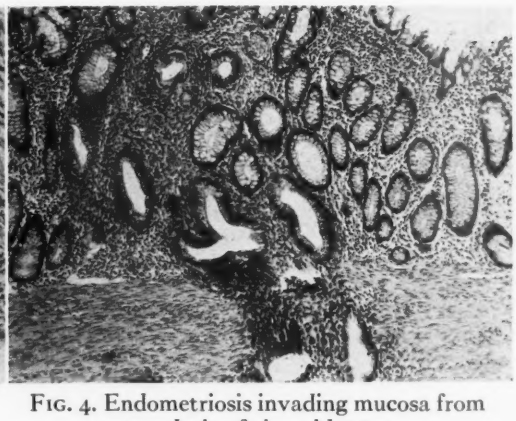

FIG. 4. Endometriosis invading mucosa from muscularis of sigmoid. × 70.

heart was not enlarged; sounds were rapid and regular with soft, apical, systolic murmur; abdomen was moderately distended; doughy, full bowel in left abdomen; cecum and transverse colon areas tympanitic; peristaltic sounds infrequent, not crescendo nor tinkling. Extremities were not edematous; tendon reflexes were active. The cervix was scarred by old laceration, slightly eroded, retrocessed, pointing posteriorly; distention prevented palpation of the fundus but the entire uterus felt fixed by rigid broad ligaments, manipulation of which caused pain; firm, tender, nonfluctuant cul-de-sac; rectum was empty. *Admission diagnosis:* Intestinal obstruction due to endometriosis of bowel or adhesions from recent cholecystectomy.

Continuous gastroduodenal suction and intravenous fluids prepared the patient for operation twenty-four hours after admission. The abdomen was opened through the upper right rectus scar encountering collapsed small producing obstruction. Accordingly, a loop of right transverse colon was exteriorized for colostomy and a catheter was inserted. Three days later the colostomy was opened and continued to function well. She left the hospital on the twenty-third postoperative day and returned two weeks later for roentgen examination which revealed a filling defect in the upper sigmoid colon suggesting extrinsic involvement. (Fig. 1.)

On September 2, 1940, the patient had gained eighteen pounds since the colostomy was formed, and she was re-admitted with the diagnosis of endometriosis of the sigmoid colon. The abdomen was opened through a left rectus incision. All small intestinal loops were interadherent by organizing adhesions resulting from the episode of obstruction. The right ovary was replaced by a 4 by 5 by 5 cm. unilocular cyst containing clear fluid. The cul-de-sac was smooth. Adherent to the posterior

surface of the left tube and broad ligament near the uterus was a loop of high sigmoid colon which was densely fixed to these structures by a 3 by 4 by 4 cm. mass infiltrating the antimesenteric half of the bowel wall. No mesenteric adenopathy was detected. Bilateral salpingooophorectomy, resection of the involved bowel and end-to-end anastomosis were performed. The colostomy spur was crushed in the usual manner during the convalescence and the patient was discharged on the twentieth postoperative day having had painless anal defecation. Readmission was necessary for further crushing of the spur and closure of the colostomy.

Pathological Report. Gross: (Fig. 2.) A 15 cm. section of slightly edematous sigmoid colon which presented, at the midpoint of the antimesenteric surface, a circular depression 6 mm. wide, 10 mm. deep and surrounded by grayish-red adhesions on the serosa. Here the lumen of the bowel admitted only a 5 mm. probe. At this point section revealed an elliptical, longitudinally situated, 25 by 8 to 15 mm. area overlying the serosal depression and characterized by atrophic mucosa from which arose two minute reddish cysts. The wall of this portion of the bowel was quite firm and 10 to 15 mm. thick, the serosa being separated from the muscularis by dense, grayish tissue deposited in radial, palisade arrangement and not grossly infiltrating the muscularis.

Microscopic: In the subserosa, muscularis and submucosa were numerous straight and convoluted gland spaces surrounded by connective tissue stroma of varying abundance. (Fig. 3.) No smooth muscle fibers were noted. The entire arrangement bore striking resemblance to endometrium, and no evidence of malignancy was detected. However, there was infiltration of the muscularis and, to a lesser degree, between the glands of the intestinal mucosa in scattered areas. (Fig. 4.) The wall of the left tube showed infiltration of similar endometrium-like tissue at the periphery.

Pathological diagnosis: Endometriosis of sigmoid colon and left Fallopian tube; hemorrhagic corpus luteum and simple follicular cyst of right ovary; Wolffian duct remnants in walls of both tubes.

COMMENT

This patient's symptoms and physical findings were sufficiently characteristic that the diagnosis of endometriosis might have been made six months earlier. The long-standing history of dyspareunia and more recent sterility suggest that the disease had been present several years. The tumor of the sigmoid was surely present at the time of cholecystectomy though undetected. Characteristic features of this case leading to the proper diagnosis were: age, recent sterility, longstanding dyspareunia, novel dysmenorrhea and menorrhagia, comenstrual constipation and rectal pain, left lower abdominal pains, lack of weight loss, painful pelvic and rectal examinations, and suggestive roentgenograms. We cannot form a definite opinion regarding the pathogenesis but believe that the sigmoid was invaded secondarily by endometriosis of the tube. Evidence of invasion of the mucosa as demonstrated by microscopic section in this case is contrary to the usual reports.

SUMMARY

Endometriosis of the bowel is of sufficiently frequent occurrence to warrant emphasis of the characteristic symptoms by review of a case in which the correct preoperative diagnosis was made, but only after acute obstruction had supervened.

Publication of detailed clinical and pathological follow-up examinations is advisable to ascertain more accurately the fate of endometriomas of the bowel which have been treated by castration without resection.*

Appreciation is accorded Dr. A. Vass, Pathologist of the Springfield Hospital, for preparation of illustrations.

* Since this paper was submitted for publication, an unmarried woman of thirty years was admitted to St. John's Hospital May 11, 1941, for treatment of dysmenorrhea and constipation. At operation a large chocolate cyst of the left ovary, rectovaginal and uterine endometriosis, and an almost completely obstructing endometrioma of the midsigmoid colon were treated by bilateral salpingo-oophorectomy, supravaginal hysterectomy and obstructive resection of the sigmoid. Distinct invasion of the mucosa was demonstrated grossly and microscopically. Complete situs inversus was an incidental finding.

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A TECHNIC FOR THE SATISFACTORY USE OF THE MILLER-ABBOTT TUBE*

JAMES B. BLODGETT, M.D.
Assistant in Surgery, Harvard Medical School
BOSTON, MASSACHUSETTS

THE Miller-Abbott tube offers an ideal physiological type of temporary treatment for intestinal obstruction. But the advantage of this therapy may be entirely lost through ineffective functioning of the tube, due to errors in management of the apparatus. It is the purpose of this paper, therefore, to record the details of an effective method for using the Miller-Abbott tube.

HISTORICAL COMMENT

The concept of treating obstruction by small intestinal drainage is not new. It was suggested in this country by Oden[1] in 1923 and advocated by Matas[2] in 1924. Wangensteen and Paine[3] improved and popularized this type of treatment by their introduction of duodenal suction in 1933. Recently, this form of therapy has been carried to its logical end by Abbott and Johnston[4] with a method of suction applied just proximal to the point of obstruction within the bowel. In order to accomplish this, a long suction tube is passed through the stomach and small bowel. Peristalsis acting upon an inflatable balloon near the tip of the tube carries it along the intestinal tract. This special apparatus was devised in 1934 by Miller and Abbott.[5] Favorable reports on its use in intestinal obstruction have been published by Abbott,[4,6] Johnston[4,7] and Leigh.[8]

DESCRIPTION OF THE TUBE

The Miller-Abbott tube† is made of medium soft rubber. It has a total length of about nine feet and a circumference of 16 mm. Smaller sizes are available. An eccentric longitudinal septum within the tube forms two unequal lumina. The smaller lumen leads into a latex balloon which surrounds the tube near the lower end. The larger lumen leads to a small duodenal bucket at the tip of the tube. There are several perforations through the wall of the tubing into the larger lumen just proximal to the balloon. Beginning at the suction tip the tube is marked off at 45, 60 and 75 cm. Sixty cm. is the usual distance from the nares to the pylorus. From the 60 cm. mark the tube is marked off in feet. Accordingly, the distance that the tip of the tube has progressed beyond the pylorus is indicated by the markings on the tube at the nose. The proximal end of the tube is fitted with double, metal suction tips leading to the separate lumina. (Fig. 1.)

INDICATIONS

Broadly, the indications for employing small intestinal suction are the same as those for the use of duodenal suction. Specifically, this type of therapy is indicated (a) for preoperative decompression when there is no evidence of vascular occlusion, (b) in the management of postoperative mechanical obstruction resulting from fibrinous exudate and (c) in the treatment of obstruction due to paralytic ileus.

The Miller-Abbott tube is effective in both paralytic and mechanical obstruction.[4,5] Small intestinal suction in the presence of obstruction represents a closer approach to normal physiological conditions than does duodenal suction. Abbott and Johnston have shown that the Miller-Abbott tube produces clinical improvement

† Supplied by the George P. Pilling & Son Company, Philadelphia, Pennsylvania.

* From the Surgical Clinic of the Peter Bent Brigham Hospital, Boston, Massachusetts.

when duodenal suction failed.[4] Accordingly, although this therapy is indicated in the same conditions as duodenal suction, its choice is desirable as a more physiological and effective agent. We have used small intestinal suction in all types of obstruction that did not present evidence of strangulation.

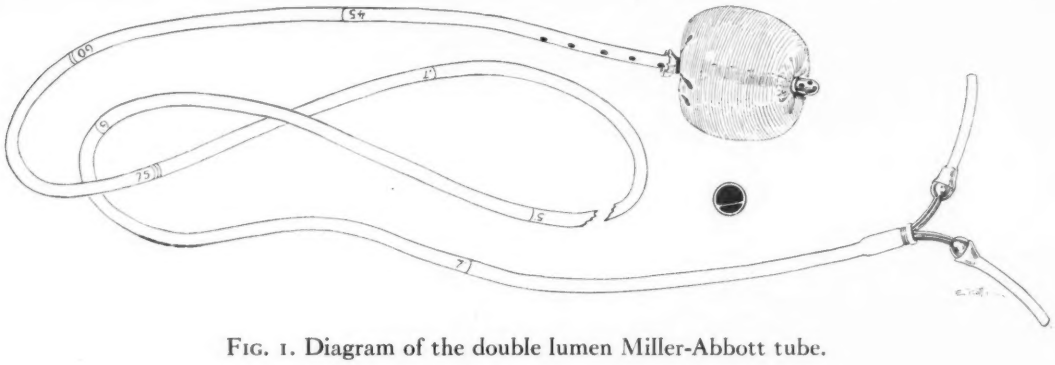

Fig. 1. Diagram of the double lumen Miller-Abbott tube.

CONTRAINDICATIONS

The possibility of strangulation or gangrene in the obstructed loop of bowel is a contraindication to small intestinal suction as well as to duodenal suction.[3] The reason is that in cases in which the intestinal vascular supply has been compromised, immediate operation should be performed to prevent a free perforation or a degree of gangrene which would make resection necessary. The use of the Miller-Abbott tube tends to minimize the symptoms and signs of strangulation and thus to diminish the urgency of operation, without improving the local situation. The presence of strangulation may be judged either on the clinical signs of elevated pulse, leucocytosis, rapid respirations, and fever, or on the presumptive basis that the particular type of lesion at hand may be especially prone to strangulation, as, for example, incarcerated hernia. If strangulation appears to be a reasonable clinical possibility, this therapy should not be elected except as preparation for immediate operation.

PREPARATION AND CARE OF THE TUBE

Each time the tube is used it is necessary to affix a new latex balloon because in the course of intubation the rubber loses its elasticity, becomes discolored and acquires an unpleasant odor. Half of an ordinary condom is used to replace the balloon. The rounded end is perforated and it is whipped onto the tube with thread. (Fig. 2A.) The thread must not be so tightly wound as to occlude either lumen by pressure. As the balloon is tied on, enough slack in the latex must be left between the proximal and distal threads so that when the balloon is inflated the overall length is greater than the length of the tube included within the balloon between the ties. In this manner, as the balloon is inflated, longitudinal *tension* will be applied to the small segment of tube passing through the balloon, and this portion of the tube will not bend. (Fig. 2.) If this precaution is not taken, as the bag is inflated a longitudinal *compression* is exerted on the segment of tube within the balloon which produces a flexion in that portion that might hinder proper passage of the tube along the intestinal tract. (Fig. 3.) It is important to test the balloon against leaks as intestinal intubation cannot be accomplished if the bag is not inflated.

After the tube has been used, the balloon and its ties should be removed to prevent the production of a permanent constriction in the rubber tubing at the points where the thread is wound about it. Since the rubber tubing may retain a somewhat unpleasant odor, even after thorough soap and water cleansing, it has been our practice to soak it in cologne or lavender water if it is to be used soon again. Holes

through the wall of the tube, which must be made without perforating the septum, may be drilled with a round dental burr of appropriate size. Drilling is facilitated by cooling the tube.

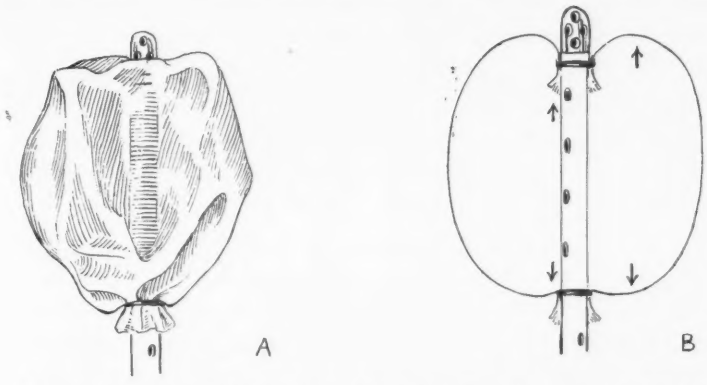

Fig. 2. A, proper method of attaching balloon, with enough slack in the rubber between ties to prevent bending of tip of the tube. B, inflation of properly attached bag produces longitudinal *tension* (see arrows) which keeps the included segment of tube straight.

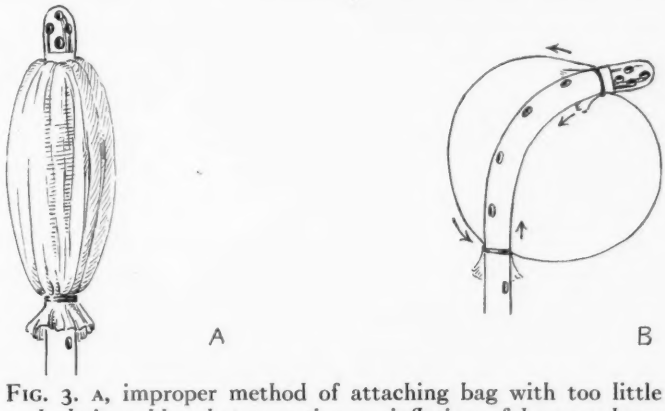

Fig. 3. A, improper method of attaching bag with too little slack in rubber between ties. B, inflation of bag produces longitudinal *compression* (see arrows) which bends the included segment of the tube, possibly making passage of tube difficult.

INTRODUCTION OF THE TUBE

Under most circumstances it is not difficult to pass the tube through the nose and into the stomach. Before the tube is passed a measurement should be taken to determine roughly how far the tube must be passed through the nose to make the tip approach the pylorus. With the bag fully deflated and lubricated with mineral oil, the tube is started through the nose which may be cocainized. If the patient is cooperative, the end is passed into the stomach with a few swallows of water which can be immediately aspirated, giving assurance that the tip has reached the stomach. *The tube is passed to a point where the end is about four inches short of the estimated distance to the pylorus.* It is then tied at the nares with a cloth tape anchored to the nose and lip by adhesive. The use of the tape to hold the tube prevents adhesive material from sticking to its rubber walls and facilitates freeing the tube for further introduction.

The most important and difficult procedure is to accomplish the passage of the tip of the tube through the pylorus. The special value of the therapy depends upon the success of this step. We have had more satisfactory results by applying suction to the stomach for several hours before attempting to pass the tip of the tube into the duodenum. The

theoretical basis for this procedure is that when the dilatation is relieved, the stomach may be better able to regain its muscular tone and peristalsis which carries the tube through the pylorus. It is important to have the patient lie upon his right side to direct the end of the tube toward the antrum.[5] Sips of clear fluid are allowed by mouth. After four hours about one inch of the tube is introduced through the nose every half hour until one more foot of tubing has been passed into the stomach. This step is designed to permit the tip to approach the pylorus slowly and to be carried into the duodenum, and not to allow the tube to coil in the stomach as a result of many inches of tubing being introduced at once. Coiling of the gastric segment of the tube resulting from too rapid introduction has been repeatedly demonstrated fluoroscopically.

After the foot of tube has been introduced slowly, an *x*-ray check should be made to determine whether the tip has entered the duodenum. If this has not occurred, there is little advantage in continuing the introduction since the tubing merely continues to coil in the stomach. In our experience, once the tube has become coiled in the stomach the tip has never been demonstrated to have passed the pylorus, and there is definite danger of the formation of a figure eight or overhand knot in the coiled tubing. Failure to recognize that the tube is not passing into the duodenum results in a delay of small intestinal intubation which may be a serious threat to the patient's welfare.

Clinical estimation of duodenal intubation is not reliable. Two presumptive signs that the tip had passed the pylorus were considered. The first was that if there is a definite change in the character of the aspirated fluid from a hazy white, mucoid material to a clear, bile-stained fluid, it may be assumed with some certainty that the tip of the tube has passed into the duodenum. This distinct change may be of real significance. However, in intestinal obstruction we have not found this sign to be a very consistent one because of the frequent incidence of regurgitation of the duodenal contents into the stomach. The first fluid aspirated from the stomach often had a duodenal character and no change was observed as the tube passed into the duodenum. Because of the character of the aspirated fluid, we have occasionally assumed that the tube was passing along the small bowel when it was in reality coiling in the stomach and giving little effect. Case v, a fatality, is an example of this fallacy. The second was that rhythmic water manometric changes in bulb pressure, which may be taken from the tube leading to the inflated bulb, may be indications of duodenal peristaltic waves passing over the bulb. Certain pressure changes have been observed in balloons that were still in the stomach and could not be differentiated from the pressure variations after the bulb had definitely passed through the pylorus. It may be that we have not yet learned to evaluate these readings properly, but we have little real confidence in the nonradiographic indications of small bowel intubation.

It appears, therefore, that *the only certain way of determining the position of the end of the tube is radiography*, either by fluoroscopy or plain film. If the patient is too ill to be moved to an *x*-ray department, portable fluoroscopy or films at the bedside are satisfactory. Most of our therapeutic failures of Miller-Abbott suction occurred as a result of unrecognized failure of the tip to pass through the pylorus because no early roentgen check was made, since it was assumed on other evidence that suction was being applied within the small bowel.

If the tube is found not to have passed the pylorus on the first attempt, it should be withdrawn so that it is in its original position in the antrum of the stomach, and the above procedure repeated. If these measures are unsuccessful in producing duodenal intubation, it is usually possible to manipulate the tip through the pylorus under fluoroscopic control. We have preferred to withhold this method until at

least two attempts at passage have been made, feeling that manipulation under the fluoroscope is fatiguing and painful to the sick distended patient.

The greatest difficulty in passing the tube has been encountered in the toxic patients with peritonitis. All manipulations are especially hard because of the uncooperative state. The stomach itself seems to be of little assistance in propelling the tip through the pylorus. Therefore, the *early decision to employ the tube at the first sign of ileus before toxic conditions arise may be a life-saving precaution.*

Miller and Abbott[5] have suggested an alternate technic of duodenal intubation. The stomach is emptied of all gas and is moderately filled with fluid. Air is introduced into the balloon. The patient is turned on his *left* side, and thus an effort is made to "float" the tip through the pylorus in contradistinction to the above described method of "sinking" it through the pylorus. We have had little experience with this procedure.

When it has been determined that the tip of the tube is well in the duodenum, the bag is inflated with 30 cc. of air. Too early or too great dilatation of the balloon at this point results in regurgitation of the tube. In Case XIV, the tip was placed into the duodenum by fluoroscopic control four times. Each time the bag was inflated with 60 cc. of air and each time the whole tube was immediately regurgitated. After the bag is properly inflated, it has been reported[5] that the tube may be carried along the jejunum at a rate of approximately two feet an hour. One foot an hour is accepted as a reasonable clinical expectation. In our cases the tube has been introduced through the nose at a rate of six inches every half hour. This is accomplished by lubricating six or eight inches of the tube at the nose, which is passed as the patient takes several swallows of water. The tube is introduced in this manner until it has passed to its full length, or until the tip is demonstrated by x-ray to have reached either the obstruction or the iliocecal junction. Wangensteen suction through collecting bottles is maintained while the tube is passing along the small intestine. The most rapid passage of the tube to the cecum was observed in a period of eighteen hours. In peritonitis it may be a matter of days. The progress of the tube can be halted at any time by deflating the balloon. The tubing should not be allowed to coil in the stomach as loops may prolapse into the duodenum and obstruct free suction by kinking the tube.

It is well to make an occasional check to be sure that the balloon is not leaking. This may be done by measuring in a syringe the amount of air that can be withdrawn from the balloon after it has been inflated for several hours. A diminution in the volume aspirated compared with the measured amount used to inflate the bag indicates the amount of leakage. To prevent clogging of the suction lumen or perforations, it has been our practice to irrigate it with 30 to 50 cc. of tap water every hour. In two cases irrigation of the suction lumen was not carried out, and in these there was unsatisfactory function of the tube because of obstruction in the lumen itself. The openings into the separate lumina at the proximal end of the tube should be clearly marked to avoid confusing them.

GENERAL CARE OF THE PATIENT

The presence of the tube offers no impediment to ordinary intake of food and liquids. In mechanical obstruction, when the tube has satisfactorily passed the pylorus, we have given clear fluids by mouth and, after about twelve hours of passage of the tube along the small bowel, soft solids were allowed. The rationale[4] for this departure is that with the return of normal intestinal flow, the function of nutrition can be re-established by the bowel proximal to the end of the tube; this is a great advantage to the patient. In two instances, after the tube had passed to the lower ileum, house diets were given without untoward effects on the function of the apparatus.

To promote comfort and prevent crusting of the nasal mucous membranes, several drops of albolene should be run into the nose along the tube every four hours. With this care tubes are well tolerated by most patients. Fifteen days is the longest interval that a tube remained in place in our cases.

During the period of suction accurate daily records of fluid intake by mouth and by parenteral routes should be kept along with the total suction and urinary output. In this way the water balance can be followed accurately. Perhaps the most significant single index of water metabolism is Coller and Maddocks,[9] criterion of the total daily urinary output. A daily output of 1,000 to 1,500 cc. of urine is considered satisfactory in the absence of cardiac or renal damage. Attention should also be directed toward the electrolyte, vitamin and protein metabolism. Protein, sodium chloride, carbon dioxide combining power, and hematocrit values of the blood are important in following the patient. None of our cases were observed to pass into acidosis which was considered as a possibility because of the constant removal of the alkaline intestinal fluids.

REMOVAL OF THE TUBE

Contrary to expectation, the tube may be easily removed, even when it has descended as far as the large bowel. The balloon is deflated and a foot or two is withdrawn each hour. This is accomplished without discomfort to the patient. We have chosen to be conservative about removing the tube because of the difficulty in replacing it. The indication for removal is the passage of fecal material and gas by rectum which demonstrates that the obstruction no longer exists. Before the tube is removed, suction should be discontinued for a long enough period to prove that the gastrointestinal tract can tolerate fluid and food by mouth without further signs of obstruction.

ADVANTAGES OF SMALL INTESTINAL SUCTION

The advantages of the Miller-Abbott therapy in intestinal obstruction may be stated as (1) control of distention, (2) physiological relief of obstruction, (3) avoidance of operative drainage of the bowel, and (4) control of postoperative distention and pressure on the suture line by continued suction after operation.

As the tip of the suction tube is propelled along the coils of gut by peristalsis, decompression is progressively accomplished by aspiration of fluid and gas from the distended loops of intestine as they are encountered. Decompression alone produces three beneficial results: The reduction of intra-intestinal pressure allows the return of adequate circulation to the bowel wall; reduced intra-abdominal pressure permits proper flow of blood in the great portal and abdominal venous channels;[10] and, as there is more room for diaphragmatic excursion, there is better pulmonary aeration which reduces the possibility of pulmonary complications and facilitates the return of venous blood by the pumping action of the thoracic cage.

Physiological relief of the obstruction is accomplished by the Miller-Abbott tube in that an outlet for the intestinal contents is provided at a point just proximal to the obstruction. In this manner the normal intestinal flow may be resumed. The normal functions of the proximal portion of the bowel are re-established, and the absorption of water, electrolytes and nutrients can be maintained.[4,10] Toxic products, which may be forming within the bowel as a result of the obstruction, as reported by Scudder, Zwemer, and Whipple,[11] can be removed by the suction. As suggested by the work of Glendel and Fine[12] in dogs, the physiological relief of the obstruction may result in the better maintenance of normal plasma protein content which is important in tissue metabolism, intestinal motility[13] and wound healing.[10] The net result of intestinal suction in obstruction is marked

clinical improvement in the individual patient and apparent reduced mortality for the group.[8]

significant information in identifying the character of the lesion.

A very definite benefit to the patient of

TABLE I

CHART OF EARLY CASES OF INTESTINAL OBSTRUCTION TREATED WITH THE MILLER-ABBOTT TUBE ARRANGED TO SHOW THAT GOOD CLINICAL RESULTS, AS MEASURED BY RELIEF OF SYMPTOMS, DEPENDED UPON SATISFACTORY SMALL INTESTINAL INTUBATION AND CONTINUED SUCTION RETURNS*

Case No.	Age	Diagnosis	Was *X*-ray Chart Made	Time Tube in Place	Volume of Suction Returns	Sucess of Small Bowel Intubation	Clinical Result
I	30	Lymphosarcoma with intestinal, peritoneal metast.	Yes	3 days	Fair	*Poor;* passed only into upper jejunum	Poor
II	48	Carcinomatosis carcinoma of pancreas	Yes	1 day	Fair	*Poor;* coiled in stomach	Poor
III	12	Acute appendicitis with perforation obst. postoperative	Yes	2 hours	Poor	*Poor;* coiled in stomach	Poor
IV	12	Perforated appendicitis: generalized peritonitis	No	3 days	Fair	*Poor;* toxic, often pulled out	Poor
V	52	Perforated ulcer with peritonitis	Yes	4 days	Fair	*Poor;* coiled in stomach	Poor
VI	42	Carcinoma, colon; peritonitis, postoperative	Yes	.....	Poor	*Poor;* coiled in stomach	Poor
VII	42	Peritoneal carcinomatosis with obstruction	Yes	2 days	Fair	Fair; passed slightly beyond duodenum	Fair
VIII	27	? Obstruction ? Hysteria	Yes	1 hour	.....	*Poor;* regurgitated after in duodenum	Poor
IX	75	Carcinoma of ascending colon	Yes	15 days	Good	Good; to cecum	Good
X	74	Carcinoma of jejunum	Yes	5 days	Good	Good; to lesion	Good
XI	62	Incarcerated femoral hernia	Yes	6 days	Good	Good; to cecum in 18 hours	Good
XII	27	Old postop. adhesions with intest. obstruction	Yes	8 days	Good	Good; to large bowel	Good
XIII	41	Cholecystitis acute and chronic	No	2 days	Good	Good	Good
XIV	13	Appendicitis intest. obstruction, postop.	Yes	4 days	Good	Good	Good
XV	28	Appendicitis, perforated postop. abscess, obst.	Yes	5 days	Good	Good	Good

* Since this chart was prepared, twenty-seven cases have been treated by intestinal suction. The results in these cases generally confirm our earlier impressions.

Diagnostic assistance in determining the type of lesion may be offered after the tip has passed to the site of the obstruction by introducing a small quantity of dilute radio-opaque fluid through the suction lumen to outline the lesion by roentgenography.[6,8] This offers accurate visualization of the obstruction with the use of a minimum amount of contrast medium which may be immediately aspirated. Study of the intestinal contents aspirated from the region of the obstruction may also give

this type of therapy is that by producing an outlet proximal to the obstruction, the necessity of an enterostomy with its accompanying risk is obviated. In fact, decompression alone, as reported by Wangensteen and Paine,[3] and often observed in postoperative obstruction caused by fibrinous adhesions, may result in complete relief of the obstruction which makes operation unnecessary.

In the postoperative management of certain cases the tube may have a useful func-

tion. If it is left in place during operation, the tip which can be felt within the bowel may be adjusted to a point proximal to the anastomosis. Thus, postoperative distention and risk of pressure on the intestinal suture line can be avoided by suction continued after the operation.

DISCUSSION

A review of the cases of intestinal obstruction in which the patients were treated with the Miller-Abbott tube at the Peter Bent Brigham hospital during the first two years shows that in a small group of patients good clinical results were obtained only if the tube was made to function properly. These patients in whom the tube worked well showed relief of distention, and improvement in nutrition and comfort. It is seen, however, that uniformly poor clinical results followed if the tube did not function properly. The most important factors causing unsatisfactory function of the apparatus were failures of the tip of the tube to pass the pylorus and to proceed along the bowel, or obstruction of the suction lumen, which is particularly likely because of its length and small size. Summaries of our early cases appear in Table 1. They are arranged to show the correlation between the above two causes of unsatisfactory function and the clinical effectiveness of the Miller-Abbott tube. Relief of clinical signs of obstruction was considered the criterion for a good result. All poor clinical results but one* (which was a case of multiple intestinal obstructions) were associated with improper function of the tube. In the light of our present experience from direct supervision of these cases, it is believed that mechanical difficulties in the use of the tube can be largely avoided and that good results may be expected with the proper technic.

* Case 1. This was a male of thirty years who entered with emaciation, marked distention and evidence of obstruction. Exploration revealed widespread peritoneal lymphosarcoma. Abbott suction was used with effective intubation of the jejunum, but little relief of the distention. Autopsy revealed multiple sites of intestinal obstruction due to peritoneal metastases.

Although roentgenographic demonstration of the obstruction was not routinely attempted, it was shown to be effective in three cases, notably Case x in which a neoplasm of the small bowel was demonstrated. Convincing data on the value of this procedure have been published[6,8] by Abbott and Leigh.

Postoperative intestinal suction was first used after a jejunal resection with good effect. It is now frequently employed and, with the adjunct of occasional gastric suction, gives good control of distention.

SUMMARY

The Miller-Abbott tube offers an ideal type of temporary therapy in cases of intestinal obstruction without strangulation. The clinical effectiveness of this treatment depends directly upon the skill with which it is used. An effective technic for the use of the Miller-Abbott tube and the care of the patient is presented.

We are indebted to Dr. Octa C. Leigh for our first Miller-Abbott tube.

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. . . It must be emphasized that *early* poliomyelitis may occur *without* any characteristic changes in the spinal fluid. If the patient presents a clinical picture in which one suspects poliomyelitis, treatment should be instituted despite failure to confirm the diagnosis by spinal fluid examination. In the absence of confirmatory findings in the spinal fluid, it is impossible to pronounce the case definitely as one of poliomyelitis; nevertheless, the patient should be given the benefit of the doubt and treated for this disease until further observation alters the diagnosis.

PNEUMOGASTROSCOPY

A PRELIMINARY REPORT

A. S. D'ELOIA, M.D.
Ossining Hospital, Ossining, New York
YONKERS, NEW YORK

WE have submitted this preliminary report on the technic of pneumogastroscopy as used by us at this time because we desire to make this simple procedure immediately available for use by other investigators. Our success with the technic encourages us to believe that its widespread use will increase the number of early discoveries of gastric cancer.

There are certain necessary limitations to the routine technic of roentgen examination of the stomach following the ingestion of an opaque meal. Unquestionably, because of these limitations this method has contributed in a large measure to the failure of early diagnosis in gastric cancer and other incipient lesions of the stomach.

FIG. 1. Stereoscopic view of stomach with expanded balloon and Miller-Abbott tube.

For practical purposes, the normal stomach may be considered a flat, hollow, elastic muscle, lined with a special mucosa. When the stomach is filled with an opaque solution, the lining mucosa and the interior of the stomach itself are obscured from direct view during the roentgen examination. It is

true that mucosal defects may frequently be encountered when a small amount of highly radiopaque material is employed and when suitable methods of compression are applied. But this technic demands a high degree of skill on the part of the examiner. The fluoroscopic findings so elicited are difficult to reproduce on the roentgenograph and the presence of obesity or thick abdominal muscles makes the examination difficult.

Were it not for the fact that most gastric lesions occur near the curvatures of the stomach and, therefore, can be thrown into relief on the projected roentgenograph, the use of an opaque medium would be without value.

Fig. 2. Same as Figure 1.

NEW TECHNIC

We have successfully employed an extremely simple technic for the visualization of the interior of the stomach that has none of the disadvantages of the opaque meal and has, in addition, many advantages of its own in the proper and early diagnosis of gastric pathological conditions.

In our early work, we passed an ordinary Miller-Abbott tube into the stomach and insufflated a sufficiently large enveloping balloon with 250 to 400 cc. of air and 50 to 100 cc. of water which was employed chiefly as ballast. (Figs. 1 and 2.) Before and after the balloon had been insufflated, a thin mixture of rugar was given to the patient to swallow and this mixture was seen evenly compressed into the gastric mucosa by the expanding balloon.

Stereoscopic roentgenographs were then made, and we were able to view and place any suspected portion of the stomach under the most thorough roentgenographic scrutiny. The resulting radiographs, as can be seen in the accompanying illustrations, present a high degree of contrast. The thin,

opaque medium is finely dispersed and thrown into sharp contrast by the intense lucency of the injected air and the visualization which results shows not only the curvatures but every part of the anterior or posterior wall of the stomach. Each part may be sharply demonstrated by the proper positioning of the patient and by the taking of stereoscopic views.

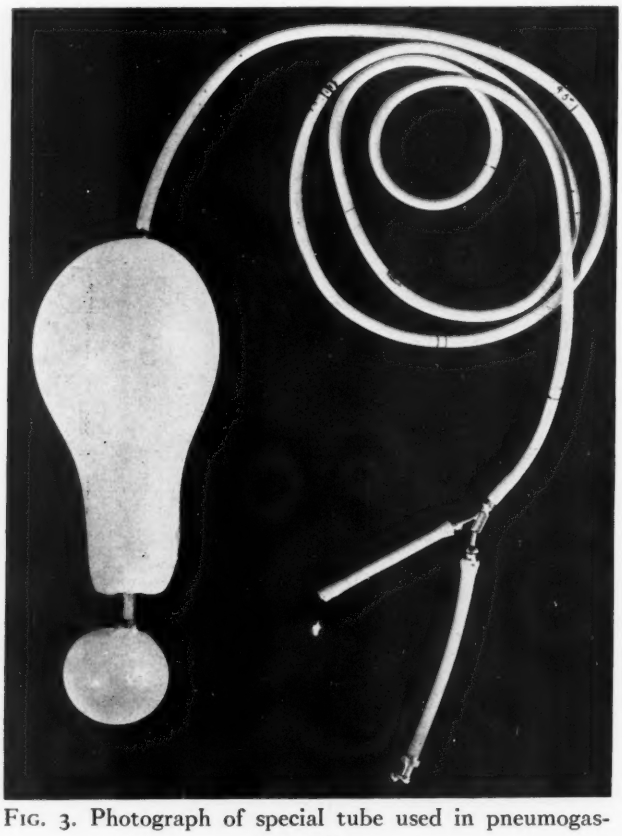

FIG. 3. Photograph of special tube used in pneumogastroscopy.

None of the patients complained of discomfort or any unusual symptoms other than those incident to the passage of the tube. They were unable to experience anything unusual as the stomach became expanded nor did they experience any discomfort at the release of pressure even when suddenly withdrawn from the expanded balloon.

This simple method described demonstrates a large portion of the stomach. However, for the proper visualization of the pyloric and prepyloric region we have employed our own specially designed tube which permits insertion of the tip and its water ballast into the cap. This tube when expanded insufflates the entire stomach and is kept in place by the pressure of the air in the stomach and the mass of the water ballast in the cap. We have not attempted to visualize the entire stomach with the simple method of attaching a balloon to a Miller-Abbott tube because of the danger of expanding the duodenum.

When the balloon is insufflated, it will naturally exert pressure in all directions and the cap obviously cannot take the same pressure as employed in the stomach. In our specially designed tube, the air is kept separated from the water ballast. Up to 50 cc. of water may be used as ballast in the duodenum and up to 500 cc. of air may be employed to expand the stomach.

ADVANTAGES OF NEW TECHNIC

In addition to making available for roentgen study the hitherto obscure inner recesses of the stomach, our method of

pneumogastroscopy has the following decided advantages over the simple opaque meal:

1. Clear and well defined small collections of barium are sealed into the defects of the mucosa by the gentle pressure of the expanded balloon. Such craters might quickly be swamped and obscured from view by a large mass of opaque fluid. These defects might also empty immediately after the passage of a fluid mass.

2. In the presence of gastric cancer whether scirrhus or fungating, there is loss of elasticity of the stomach wall. This is the most characteristic and constant finding of stomach cancer. Up until the present, the cicatrix necessarily had to be of an appreciable size, large enough to produce a gross defect on the curvature of the stomach and large enough so that the examiner might note the interruption of the peristaltic wave. By our own technic, the cicatrix may be outlined extremely early in the disease. The wall of the stomach shows a marked alteration in its expansibility at the site of the cicatrix.

This tube is being manufactured by the George P. Pilling & Son Company, of Philadelphia.

The patient with encephalobulbar poliomyelitis is much more acutely ill, and in a more critical condition than one with other types of poliomyelitis, and the prognosis is poor. A very frequent complication is pneumonia, usually due to aspiration of mucus from the paralyzed throat.

THE USE OF PROSTIGMIN IN ABDOMINAL AND VAGINAL OPERATIONS FOR THE RELIEF OF POSTOPERATIVE DISTENTION AND URINARY RETENTION IN A SERIES OF 96 CONSECUTIVE CASES*

I. TRACTENBERG, M.D. AND WILLIAM OLIVER, M.D.
BROOKLYN, NEW YORK

POSTOPERATIVE distention has always been a problem not only perplexing to the surgeon but distressing to the patient. The majority of patients having a laparotomy even in the hands of the most skilled operators have postoperatively, usually within from twelve to twenty-four hours, a functional inactivity of the gastrointestinal tract which may be followed by abdominal distention although the manipulation, if any, of the viscera has been very slight.

The most frequent causes of postoperative distention are trauma and exposure of the intestines to air during laparotomy. Undoubtedly, prolonged operations, rough manipulation of tissues, excessive handling of viscera, and long continued, unskilled administration of anesthetics are additional contributing factors in the etiology of this disorder. However, the actual mechanism of distention is still obscure.

We believe that the appearance of distention is a warning that the normal tonus of the digestive musculature has been lost. When motility of the gastric musculature is impaired the resulting atony is often followed by markedly increased secretion from the walls of the stomach or intestines. As absorption from the gut decreases the bowels become filled with large quantities of toxic fluid. As a result of the increased intraintestinal pressure, the blood vessels within the intestinal wall are compressed. This causes a complete impairment of peristalsis and results in acute gastric dilatation or paralytic ileus.

To prevent the above condition, treatment should be instituted as early as possible. It is of great value to recognize early postoperative distention and to distinguish it from obstruction. The former always develops within twenty-four or forty-eight hours after the operation while the latter develops several days after a laparotomy.

Of the large number of drugs which have been used clinically in attempts to stimulate peristaltic activity of the intestines the most important are those of the pitressin and surgical pituitary types and prostigmin. It has been our clinical experience that prostigmin has given excellent results in most of our cases.

Prostigmin, or the dimethyl-carbamic ester of m-oxyphenyl-trimethyl-ammonium-methylsulfate, is a chemical entity marketed in two parenteral forms, both of which were used in the present study. The "therapeutic" form, or prostigmin, 1:2000, contains ½ mg. of prostigmin per cc. of solution. The "prophylactic" form, or prostigmin 1:4000, contains ¼ mg. of prostigmin per cc. of solution.

The use of prostigmin in our cases, preoperatively and postoperatively, reduced to a minimum the incidence of abdominal distention and proved to be effective in preventing paralytic ileus.

In our early series of cases, in which we used prostigmin twenty-four to forty-eight hours postoperatively at the onset of distention, our results, though fairly good, were not as satisfactory as those obtained when the drug was used preoperatively as well.

* From the Department of Gynecology, Service of Dr. I. Tractenberg, Unity Hospital, Brooklyn, New York.

TABLE I

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
1	R. G.	52	Supracervical hysterectomy	12 hrs. post-op. 1:2000 every 3 hrs. for 6 doses	Rectal tube	‡	
2	S. L.	43	Total hysterectomy and perineorrhaphy	Pre-op. 1:4000, immed. post-op. 1:2000 and every 3 hrs. for 6 doses		†	No catherization
3	B. F.	62	Vaginal hysterectomy and perineorrhaphy	Pre-op. 1:4000, immed. post-op. 1:2000 and every 3 hrs. for 6 doses		*	No catheterization
4	C. T.	41	Supravaginal hysterectomy	24 hrs. post-op. 1:2000 and every 3 hrs. for 6 doses		‡	3 catheterizations required
5	A. B.	44	Supravaginal hysterectomy	Pre-op. 1:4000, post-op. 1:2000 and every 3 hrs. for 6 doses	Rectal tube	*	1 catheterization required
6	F. L.	44	Total hysterectomy and perineorrhaphy	Post-op. 1:2000 and every 3 hrs. for 6 doses		†	
7	L. M.	63	Hysterectomy and perineorrhaphy	48 hrs. post-op. 1:2000 and every 3 hrs. for 6 doses		§	Distention marked; catheterization required for 5 days
8	M. N.	48	Supravaginal hysterectomy, appendectomy and salpingo-oopherectomy	Pre-op. 1:4000, immed. post-op. 1:4000 and every 3 hrs. for 6 doses		*	1 catheterization
9	N. S.	52	Supravaginal hysterectomy and perineorrhaphy	12 hrs. post-op. 1:2000 and every 3 hrs. for 6 doses		†	1 catheterization
10	C. N.	56	Total hysterectomy and perineorrhaphy	Pre-op. 1:4000 post-op. 1:2000 3 hrs. for 6 doses		†	1 catheterization
11	N. T.	54	Supracervical hysterectomy and perineorrhaphy	Pre-op. 1:4000 post-op 1:2000 every 3 hrs. for 6 doses		*	
12	T. S.	51	Total hysterectomy	24 hrs. post-op. 1:2000 3 hrs. for 6 doses	Rectal tube and enema	‡	
13	M. S.	61	Vaginal hysterectomy	Pre-op 1:4000 post-op 1:2000 every 3 hrs. for 8 doses		*	
14	D. F.	43	Vaginal hysterectomy and perineorrhaphy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses		*	

TABLE I (*Continued*)

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
15	F. R.	68	Vaginal hysterectomy	Pre-op. 1:4000 post-op. 1:2000 3 hrs. for 6 doses	Rectal tube and enema	†	
16	B. R.	64	Vaginal hysterectomy	Pre-op. 1:4000 post-op. 1:2000 3 hrs. for 8 doses		*	
17	R. S.	69	Vaginal hysterectomy	12 hrs. post-op. 1:2000 3 hrs. for 6 doses	Rectal tube and enema	‡	4 catheterizations
18	S. H.	52	Vaginal hysterectomy and perineorrhaphy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses		*	
19	N. M.	49	Total hysterectomy and perineorrhaphy	Post-op. 1:4000 and every 3 hrs. for 6 doses	Rectal tube and enema	†	1 catheterization required
20	S. B.	58	Total hysterectomy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses	Rectal tube	†	
21	R. G.	43	Supracervical hysterectomy	24 hrs. post-op. 1:4000 every 3 hrs. for 6 doses	Wangensteen	§	4 catheterizations
22	P. O.	49	Supracervical hysterectomy left salpingo-oopherectomy and appendectomy	Pre-op. 1:4000 post-op. directly 1:2000 every 3 hrs. for 6 doses	Wangensteen	†	1 catheterization
23	M. M.	39	Supracervical hysterectomy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses		*	
24	L. L.	59	Supracervical hysterectomy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses		*	
25	J. F.	39	Supracervical hysterectomy and perineorrhaphy	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses	Gastric lavage	†	
26	S. C.	31	Supracervical hysterectomy	Post-op. every 3 hrs. —6 doses pre-op. 1:4000	Levine tube	†	1 catheterization
27	B. O.	42	Supracervical hysterectomy anterior and posterior colporrhaphy	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 8 doses		†	1 catheterization
28	L. F.	51	Supracervical hysterectomy and appendectomy	24 hrs. post-op. 1:2000 every 2 hrs. for 6 doses		‡	

TABLE I (*Continued*)

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
29	A. M.	43	Hysterectomy	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses		*	
30	E. S.	63	Vaginal hysterectomy (clamp)	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 8 doses		*	1 catheterization
31	C. F.	59	Vaginal hysterectomy (clamp)	12 hrs. post-op. 1:2000 given every 3 hrs. for 6 doses		†	4 catheterizations
32	T. L.	61	Vaginal hysterectomy (clamp)	Pre-op. 1:4000, 1:2000 directly post-op. given every 3 hrs. for 6 doses		*	
33	B. F.	64	Vaginal hysterectomy	1:4000 pre-op. 1:2000 directly post-op. given every 3 hrs. for 6 doses		*	1 catheterization
34	S. M.	28	Right salpingectomy and appendectomy	Immed. post-op. 1:2000 given every 3 hrs. for 6 doses		†	
35	J. L.	31	Bilateral salpingectomy	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses		*	
36	G. T.	23	Right salpingectomy and appendectomy	Immed. post-op. 1:2000 given every 3 hrs. for 6 doses	Rectal tube Levine tube	†	1 catheterization
37	I. J.	36	Bilateral salpingectomy	1:2000 directly post-op. given every 3 hrs. for 6 doses		†	
38	M. W.	32	Left salpingectomy; separation of adhesions	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses		†	
39	M. E.	31	Bilateral salpingectomy	None given	Rectal tube; Levine tube; turpentine stupes	§	
40	M. F.	26	Right salpingectomy; separation of adhesions	24 hrs. post-op. 1:4000 given every 3 hrs. for 6 doses	Levine tube, enema	§	
41	W. G.	33	Bilateral salpingectomy; separation of adhesions	1:2000 given 36 hrs. post-op.		§	

TABLE I (*Continued*)

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
42	B. T.	29	Bilateral salpingectomy; separation of adhesions	24 hrs. post-op. 1:2000 given every 3 hrs. for 8 doses		‡	
43	S. O.	20	Right salpingectomy; resection of right ovary	1:4000 pre-op. 1:2000 post-op. given every 3 hrs. for 6 doses		*	
44	E. F.	19	Left salpingectomy and appendectomy	Pre-op. 1:2000 post-op. 1:2000 given every 3 hrs. for 6 doses		†	
45	T. L.	22	Right salpingectomy and appendectomy	Pre-op. 1:4000-1:2000 post-op. given every 3 hrs. for 8 doses		*	
46	I. W.	34	Right salpingectomy enucleation of a small fibroid	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses		†	
47	M. P.	34	Right salpingectomy and appendectomy	24 hrs. post-op. 1:2000 given every 3 hrs. for 6 doses		‡	
48	S. C.	36	Bilateral salpingectomy	None given	Rectal tube, enema	‡	
49	M. T.	40	Bilateral salpingectomy, defundation	24 hrs. post-op. 1:2000 given every 4 hrs. for 6 doses		‡	
50	R. V.	29	Left salpingectomy; uterine suspension	24 hrs. post-op. 1:2000 given every 3 hrs. for 6 doses		‡	
51	Q. M.	38	Bilateral salpingectomy; defundation	Pre-op. 1:4000 post-op. 1:2000 given every 2 hrs. for 8 doses		*	
52	B. F.	52	Anterior and posterior colporrhaphy	Pre-op. 1:4000 post-op. 1:2000 given every 3 hrs. for 6 doses		*	1 catheterization
53	G. K.	42	Anterior and posterior colporrhaphy and trachelorrhaphy	Pre-op. 1:4000 post-op. 1:2000 every 3 hrs. for 6 doses		†	
54	B. P.	56	Anterior and posterior colporrhaphy and hemorrhoidectomy	1:4000 night before operation 1:4000 pre-op. 1:2000 post-op. every 3 hrs. for 5 doses		*	
55	C. P.	36	Anterior colporrhaphy	1:2000 post-op. every 3 hrs. for 6 doses		*	2 catheterizations

TABLE I (*Continued*)

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
56	I. M.	29	Posterior colporrhaphy and hemorrhoidectomy	1:2000 12 hrs. post-op. every 3 hrs. for 4 doses		‡	
57	E. D.	48	Anterior and posterior colporrhaphy and trachelorrhaphy	12 hrs. post-op. 1:2000 every 3 hrs. for 6 doses		‡	4 catheterizations
58 to 63	6 additional cases Anterior and posterior colporrhaphy			1:4000 pre-op. 1:2000 immed. post-op. every 3 hrs. for 6 doses		*	No catheterizations
64	I. S.	24	Unruptured ectopic pregnancy	1:2000 12 hrs. post-op. given every 3 hrs. for 4 doses		‡	
65	M. L.	26	Unruptured ectopic pregnancy	1:2000 24 hrs. post-op. given every 3 hrs. for 5 doses	Enema, rectal tube	§	
66	A. S.	36	Unruptured ectopic pregnancy	1:4000 pre-op. 1:2000 immed. post-op. every 2 hrs. for 6 doses		*	
67	M. W.	34	Ruptured ectopic pregnancy, intraabdominal hemorrhage	1:4000 pre-op. 1:2000 immed. post-op. every 2 hrs. for 8 doses		†	
68	G. H.	31	Ruptured ectopic pregnancy	1:2000 immed. post-op. given every 3 hrs. for 8 doses	Enema	†	
69	Z. F.	29	Unruptured ectopic pregnancy	None given	Enema after 2 days	‡	
70	E. S.	14	Ruptured appendix, appendectomy	1:4000 immed. post-op. 1:4000 given every 3 hrs. for 8 doses	Rectal tube; Wangensteen	‡	
71	M. P.	30	Appendectomy (ruptured), peritonitis	1:2000 post-op. every 3 hrs. for 16 doses	Wangensteen; turpentine stupes	‡	
72 to 79	8 Appendectomies			1:4000 pre-op. 1:2000 post-op. every 3 hrs. for 8 doses		*	
80	B. A.	39	Ruptured appendectomy, peritonitis	1:2000 immed. post-op. 1:2000 every 3 hrs. for 12 doses	Rectal tube; Wangensteen	‡	
81	S. G.	22	Ruptured appendectomy, peritonitis	1:2000 24 hrs. post-op. 6 doses for every 3 hrs.	Wangensteen; rectal tube	§	

TABLE I (*Continued*)

Case	Initials	Age	Operation	Prostigmin	Other Medication	Results	Remarks
82	M. F.	23	Cesarean (classical) section	1:4000 pre-op. 1:2000 post-op. every 3 hrs. for 6 doses		*	
83	C. M.	32	Cesarean (flap) section	1:2000 24 hrs. post-op. and 1:2000 every 3 hrs. for 6 doses		‡	
84	D. V.	41	Cesarean (classical) section	1:2000 18 hrs. post-op. every 3 hrs. for 6 doses		‡	
85	E. L.	29	Cesarean (classical) section	1:4000 pre-op. 1:2000 post-op. every 3 hrs. for 6 doses	Rectal tube	*	
86	N. A.	29	Repair of femoral hernia	1:4000 pre-op. 1:2000 immed. post-op. every 3 hrs. for 6 doses		*	
87	K. W.	38	Repair of femoral hernia and perineorrhaphy	1:4000 pre-op. 1:2000 post-op. and every 3 hrs. for 6 doses		†	
88	L. A.	33	Laparotomy for large ovarian cyst	1:4000 pre-op. 1:2000 post-op. and every 3 hrs. for 6 doses		†	
89	I. B.	26	Salpingo-oopherectomy appendectomy	1:4000 pre-op. 1:2000 post-op and every 3 hrs. for 6 doses		†	
90	H. J.	38	Interligamentous cyst and appendectomy	None given	Enema, rectal tube; turpentine stupes; Levine tube	‡	

KEY

* No distention.
† Some distention, the patient in a state of slight discomfort.
‡ Marked distention with intermittent relief.
§ Severe distention with no evidence of improvement for forty-eight hours.

In the ninety-six cases presented, the following operations were performed: fourteen supravaginal hysterectomies, six total hysterectomies, eight vaginal hysterectomies, eighteen salpingectomies twelve cystocele and rectocele operations eight salpingo-oophorectomies and appendectomies, twelve appendectomies (four ruptured), six ectopic pregnancies (two ruptured), four cesarean section, two femoral hernias, one laparotomy for pedunculated fibroid in a woman two months pregnant, four vaginal hysterectomies (clamp method), and one laparotomy for very large ovarian cyst. Additional details concerning most of these patients are presented in tabular form.

CONCLUSION

In our series of ninety-six cases, the use of prostigmin has been followed by almost uniformly excellent results and in no in-instance produced untoward effects, either systemic or local.

FACIAL RECONSTRUCTION WITH ACRYLIC RESIN*

FREDERICK T. MUNSON, M.D., F.A.C.S. AND
Otolaryngologist, Alexander Blain Hospital

DAVID F. HERON, D.D.S.
Dental Surgeon, Alexander Blain Hospital

DETROIT, MICHIGAN

IN the correction of gross anatomic defects such as the loss through disease or injury of a nose, cheek or ear, dentistry has made and is continuing to make important contributions. Artificial restorations made of various materials used in dentistry are particularly valuable in those cases necessitating radical corrective measures, in which the organ or part has been completely or largely removed.

Carcinoma involving the skin of the nose, for example, is a curable disease in its early stages, and the usual treatment by irradiation or surgery leaves only minor scarring. Yet, in spite of the intensive educational campaign of recent years, many carcinomas of this type are still permitted to reach an advanced stage. Treatment of advanced skin cancer entails great destruction of the involved area and subsequent restoration of the lost tissue by means of plastic surgery whenever possible. Plastic reconstruction, however, is often impractical for economic reasons or ill-advised because of the age and general debility of the patient. Even when such surgical reconstruction is indicated and the surgeon feels fairly sure that the disease has been cured, many months should be allowed to elapse before any attempt at plastic surgery is considered. This is a difficult period for the patient and he is ostracized from society. The prosthetic appliances advocated here are a means of returning the patient to society even before the wound is completely healed.

The cases illustrated here are those of patients with advanced carcinomas for which radical measures were necessary to eradicate the disease. In the same category one might place cases of gross destruction of soft tissue and bony structure caused by such infectious diseases as syphilis and tuberculosis. Also, when facial parts have been destroyed in accidents and the age or economic status of the patient is a factor, a prosthesis of this type is most satisfactory, even if only as a temporary measure.

The restoration of lost parts of the face by the rapid and relatively inexpensive means of prosthetic appliances offers tremendous possibilities in injuries of war and accidents incurred in war industries. In the present world holocaust, reports and pictures from abroad indicate that there are many injured persons, both soldiers and civilians—even children—who will require rehabilitation by temporary or permanent restorations of this type. During the last World War interest in remedying facial defects by prosthesis was sufficient to warrant the formation of classes in many of our leading dental schools for instruction in what was then termed "war prosthesis." The type of injuries received as a result of present-day methods of warfare would indicate that a revival of interest in this subject is imminent, and with the new materials available, it will now be possible to make improved restorations with simplified technics.

In the cases presented here two different types of material have been used. In the first two cases the milky exudate of the rubber tree known commercially as latex was used, as described by one of us[1] in a previous article; in the third case, a new commercial product, one of the acrylic resins, was the material chosen. So far as can be ascertained from the literature, the material has not previously been used for this purpose except experimentally.

Reconstruction of facial parts with prosthetic appliances is not new. As early as 1905 Ottofy[2] suggested the use of materials employed by dentists. The idea, however,

* From the Department of Otolaryngology and Oral Surgery, Alexander Blain Hospital, Detroit, Michigan.

of an attempt to restore lost parts by an artificial contrivance probably dates back into antiquity. Ottofy constructed an artificial nose of vulcanite, a combination of rubber and sulphur used as a denture-base material. Zinsser[3] in 1913 published a formula which consisted chiefly of gelatin and glycerin, and in 1928 Bercowitch[4] reported an improvement in this formula made possible by the addition of preserving and coagulating agents. Meanwhile there were scattered reports of cases in which vulcanite restorations were made, and again in 1935 several cases were reported by Batson[5] in which a variety of facial defects were corrected with appliances made from the gelatin-glycerin combination. During the first World War numerous such restorations were made for injured French soldiers. The material used, as reported by Kazanjian,[6] was electroplated copper. These appliances had the advantages of permanency and the possibility of added retention because various devices for anchorage could be soldered onto the material, and the obvious disadvantage of their unnatural appearance.

Very recently Bulbulian[7,8] experimented with the liquid rubber compound, latex, giving Clarke[9] credit for first suggesting this material. The product originally used by both Bulbulian and ourselves was imported for commercial purposes; ours was obtained from a manufacturer of automobile parts. It is the same material used in making surgeons' rubber gloves and sponge rubber hospital mattresses. When it arrives in this country with only ammonia added as a preservative, vulcanizing and accelerating agents are added by the distributors. In this prevulcanized form it may be kept in a liquid state for some time if care is taken to keep the container tightly closed when not in use, as it automatically cures itself upon exposure to air.

A B

FIG. 1. A and B, restoration of a nose with a prosthetic appliance made of latex (right). The organ was partially destroyed because of advanced skin cancer (left).

The technic employed with latex is very simple. A mold in the negative likeness of the desired restoration is obtained as will be described later. It is filled with the liquid rubber which is then allowed to cure. The positive likeness thus obtained in semisoft rubber constitutes a restoration that has a texture and pliability not unlike flesh. This material was found by us to be superior to any previously recommended, the only difficulty being in coloring it to resemble human skin. A simple technic for the use of this material was reported last year[1] and it

was hoped that by this time the difficulties encountered in coloring would have been overcome. But despite the fact that an improved product is now manufactured in five colors expressly for this type of work, the results are still far from satisfactory. In our hands the new product did not mold itself as well, nor could it be matched so well to the surrounding skin as the old product with the addition of dyes.

A B

Fig. 2. A and B, latex restoration (right) made for another patient in whom very radical measures were necessary in the treatment of an advanced carcinoma (left).

The restoration of a nose shown in Figure 3 was made with acrylic resin, a material now used extensively as a denture base. While several investigators experimented with acrylic acid derivatives prior to the year 1900, the material came into wide use in the arts and sciences in this country only as recently as 1939. The industrial development of these resins was due mainly to the research of Röhn[10] of Germany who reported his investigations in 1900. In 1931 the acrylic resins first became available commercially in the United States. Acrylics is the term applied to the various resins made from polymerized derivatives of acrylic acid, CH_2:CHCOOH and methacrylic acid, CH_2:-C—COOH. This product comes to the dentist in the form of a pink powder, a white powder and a colorless liquid. By gradually blending the pink with the white powder and using the clear liquid as a binder, mixing and curing by the same process as is used in the making of a denture, a result is obtained that closely resembles the color of skin.

Acrylic restorations have been made for three of our patients and, although this material is tactually inferior to the liquid rubber, its advantages in color, cleansability and permanence would seem to make it the material of choice, at least for the present. The matter of expansion and contraction can be allowed for in the technic employed; however, there appears to be a trifle less shrinkage at present in the acrylic resin. The technic for its use as developed with the aid of Mr. John Lang of the dental department is as follows:

TECHNIC

First, a good impression is obtained of the area to be restored, together with as much of the surrounding tissue as is de-

sired. The impression is taken preferably with one of the hydrocolloids, particularly if any "undercuts" are present. This material melts at a fairly low temperature and causes little or no discomfort to the patient.

A B

FIG. 3. A and B, restoration of a nose with an acrylic resin appliance (right). In this patient the nose was completely destroyed by surgical measures necessary in the treatment of cancer of the organ further complicated by tuberculosis (left).

Next the impression is poured in plaster or artificial stone. The resulting cast is a positive likeness of the area remaining and the adjacent tissues. The missing portion, i.e., the part to be restored, is then carved in wax. On several of our cases this work was facilitated by taking an impression of the nose or ear of another person on whom this anatomical feature had a general resemblance to the one lost by the patient. This impression was likewise taken with hydrocolloidal material, but this time it was poured in baseplate wax. The wax nose can literally be shelled out. It is then further molded and carved to the esthetic appearance desired and adjusted to the plaster cast.

At this stage the patient is requested to return, the wax nose is tried on and further adjustments are made to harmonize with the patient's features. The wax pattern is then invested in two parts by a technic familiar to every dentist, the first part being allowed to harden before the second half is poured. The wax is then melted out, the two parts of the cast separated, cleansed thoroughly, allowed to dry, and both halves are foiled, molding the tinfoil carefully around the configurations.

A rather thick mix of the acrylic resin, of the same consistency as in making a denture, is now pressed between the two halves of the plaster cast, care being exercised to see that the mass fills all undercuts that may be present. The two halves are closed tightly and the acrylic resin is cured by submitting it to either moist or dry heat at a temperature of approximately 250°F., the same process as is required in making a denture of this material.

After the curing process is completed, the case is removed from the cast, polished and stippled to simulate the skin of the individual patient. If the restored part is very thick, as in the case of a nose, it may be hollowed out. This allows for better aeration as well as for the desired translucency.

Eyeglasses are used to aid in retaining the artificial nose on the face. Previously we have in several instances recommended the harmony with the surgeon, who in most instances is an otorhinolaryngologist. The surgeon, bearing in mind the need for

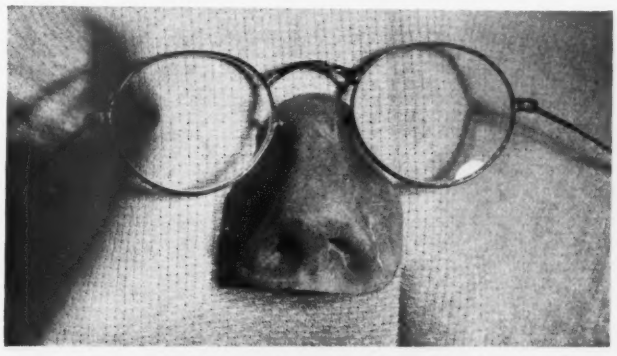

Fig. 4. The artificial nose is retained in place by the shape of the defect and the use of eyeglasses. The acrylic resin nose is hollowed out for better aeration and greater translucency.

use of a thick makeup foundation covering the entire face for an improved esthetic result. With a restoration made of acrylic resin we believe that, aside from rouge and powder, no other cosmetics are required.

CONCLUSIONS

A means for the immediate restoration of anatomic facial defects is needed in those cases of disease or injury in which the extent of the defect and the age or economic status of the patient render reconstruction by plastic surgery impractical or ill advised. An ideal material for this work must first of all closely resemble the skin in color and translucency. It must not be irritating to the sensitive tissues with which it comes in contact; it must not change shape, it should be sanitary, and the technic required to construct the appliance should not be too complicated, thereby making the procedure too expensive. At the present time acrylic resin, with several advantages over liquid rubber, would seem to be the material of choice. It is hoped that a material having all the present advantages of acrylic resin plus pliability and a better texture will be evolved from further experiments with the new plastics.

For most satisfactory plastic and esthetic results, the dentist or technician who is to make the appliance should work in close prosthesis, can do much to bring the injured parts together and shape them in such a way that adequate retention will be provided for a restoration, with the objective in mind that finishing lines will occur in the shadows of the face where they will be least noticeable. In planning the restoration, the dentist in turn should utilize all the natural advantages offered by the shape of the defect to secure maximum retention for the appliance.

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CEREBRAL COMPLICATIONS FOLLOWING SURGICAL OPERATION*

PREVENTION AND TREATMENT

ALBERT BEHREND, M.D.
Assistant Attending Surgeon, Division of Thoracic Surgery, Philadelphia General Hospital

AND

HELENA A. RIGGS, M.D.
Head of the Division of Neuropathology, Philadelphia General Hospital

PHILADELPHIA, PENNSYLVANIA

THE term, "anoxia," popularly calls to mind the image of a patient struggling for air. The face is livid and if an incision has been made, the blood welling up in the wound is alarmingly dark. In short, the patient is "cyanotic." This is a rather spectacular example of acute anoxia. The cause, as a rule, is evident and the treatment is obvious. There are, however, many circumstances under which a relative degree of anoxia may persist over a period of months or years. In such cases the symptoms are few and indeed they may be absent. Nevertheless, such a subacute or chronic anoxic state leaves a characteristic imprint on tissues in the form of increased fibrosis and cellular degeneration. Furthermore, it lowers the physiologic margin of reserve. The clinical manifestations of relative anoxia may be confined chiefly to one organ or system but study of the histologic pathology reveals evidence of widespread changes in every part of the body.

Appreciation of these facts is essential in devising a plan to aid in the prevention and treatment of cerebral complications which may follow surgical operation. We believe that "postoperative cerebral complications may occur as a result of cerebral anoxia; that the anoxia is usually secondary to an acute circulatory collapse precipitated by the administration of an anesthetic, plus the trauma of operation in individuals whose margin of circulatory reserve has been reduced."[1,2]

The difficulties inherent in proper appraisal of the ability of some patients to withstand surgical operation are well known to all clinicians. We are not so much concerned about the obvious "bad risk." In such cases laboratory methods usually confirm clinical judgment. The experienced surgeon and anesthetist are prepared for any eventuality and take every precaution to safeguard the patient. Preoperative preparation, choice of procedure, of anesthetic and postoperative care usually receive special consideration. This additional consideration of the patient is extremely important and our cognizance of this may account for the relatively small number of cerebral complications occurring in the type of case in which they might be logically expected.

Not so simple to detect and possibly of greater importance are those cases of occult impairment of the patient's reserve powers. Such cases are usually difficult to detect clinically and may be unrecognizable even by laboratory methods at our disposal. It is not practical to subject each surgical patient to a great number of clinical or laboratory procedures to evaluate possible preoperative reserve. The expense and time consumed could be justified only if there were a reasonable chance of gaining valuable information, and at present such justification does not exist. In many surgical cases time would not permit of such preoperative evaluation. Finally, most of

* From the Department of Thoracic Surgery, Philadelphia General Hospital and the Division of Neuropathology, the Laboratories, Philadelphia General Hospital.
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the clinical tests of visceral function are insufficiently delicate to detect latent alterations in physiologic function which may become significant only under the added stress imposed by surgical operation.

What preventive measures are available, then, against these postoperative cerebral complications which result from the additional anoxia of anesthesia and surgical procedure on patients with latent circulatory insufficiency?

Surgeons and anesthetists should be prepared to accept the fact that even in the absence of clinical signs, relative degrees of anoxia exist in many patients requiring surgical operation; the patient who has chronic cardiocirculatory disease, the patient who is anemic, the patient in shock, the patient with hyperthyroidism or diabetes mellitus, the jaundiced patient, the patient with diarrhea or vomiting—all those and many others suffer from varying degrees of tissue anoxia. In such cases surgical operations almost invariably superimpose additional anoxia.

The surgeon must exercise eternal vigilance before, during and after operation. At times this is extremely difficult to maintain. This is especially true when the surgeon must accept the responsibility not only for the performance of the surgical operation but also for the administration of the anesthetic. Nevertheless, a high degree of co-operation between anesthetist and surgeon can be obtained if the surgeon receives a periodic verbal report as to the state of the pulse, respiratory rate and blood pressure during the operation. The surgeon should never hesitate to abandon the operative procedure temporarily and to devote his entire attention to the measures which will restore normal respiratory and circulatory function in the anesthetized patient. This may require intravenous therapy, blood transfusion and introduction of an intratracheal catheter, aspiration of the air passages or mechanical methods of aiding respiration. In many instances, the temporary abandonment of the operation, the removal of retractors, the covering of the wound with hot moist packs and a two or three minute rest period, suffices to raise the blood pressure toward normal levels. The tendency to add speed in an effort to complete the operation in the face of a falling blood pressure is to be deplored; most commonly this results in added trauma and greater drop in the blood pressure.

The importance of maintaining a comparatively (for the individual patient) normal blood pressure during operation has already been suggested. Blood pressure reflects the tone of the circulatory system and gives early intimation of impending circulatory collapse. If the operation is of such magnitude that an appreciable fall in blood pressure must be anticipated the prophylactic infusion of intravenous fluids should be begun before the skin incision is made. Fluid is usually administered in the form of 5 per cent dextrose solution and may be supplemented by whole blood when necessary.

Spinal anesthesia is becoming more and more popular and justly so, but it requires a special word of caution. Spinal anesthesia commonly produces depression of the blood pressure. While in many cases the cerebral manifestations of such a drop may be absent, or at most, confined to a more or less severe postoperative headache, the surgeon must not lose sight of the fact that such depressions of blood pressure are potentially dangerous since depression of blood pressure implies temporary insufficiency of blood flow and, therefore, relative oxygen lack to essential viscera. In most cases the use of ephedrine sulphate or neosynephrine hydrochloride is almost uniformly effective in restoring the blood pressure to its preoperative level. However, caution must be used in administering these drugs when the blood pressure has fallen to or below the critical level, since the vasoconstrictive effect of the drug may accentuate the effect produced by pooling of blood in the venous system.

Equally important as the maintenance of blood pressure is an adequate supply of

oxygen during the operative and postoperative periods alike. Obstruction of the airway from any one of a number of causes may bring about serious embarrassment to respiratory function during and after the course of an operation. Such obstructions are particularly common in operations upon the nose and throat, the thyroid gland, and in an emergency in which an anesthetic must be administered without benefit of a preparatory period of starvation. The value of oxygen therapy in the treatment of many medical and surgical diseases has long been recognized. Perfection of newer methods of administration of the gas such as the B. L. B. mask which promotes the administration of oxygen in concentrations of almost 100 per cent has extended its availability. The wider use of oxygen therapy in the immediate postoperative period in which it is warranted by severity of the operation, lowered blood pressure and rapid pulse, dyspnea or cyanosis, and in cases of severe anemia, serves to prevent postoperative complications.

There has been a growing tendency in recent years toward the wider use of hypnotic and sedative drugs, particularly of the barbiturates in the preoperative period. The judicious use of such drugs doubtless helps to maintain the psychic equilibrium of the nervous patient before operation. Too often, however, such large doses of drugs are used that the patient comes to operation with a greatly depressed respiratory center and a state of subacute anoxia already present. Such patients, when subjected to the additional anoxia of anesthesia, become potential victims for regrettable and avoidable cerebral accidents. Too much emphasis cannot be placed upon the danger of overdosage with barbiturates and opiates in daily surgical practice, as well as in obstetrics.

Of prime importance in the prevention of cerebral accidents is a thorough knowledge of the factors which might precipitate such complications. While there is some excuse for failure to carry out a multitude of laboratory procedures, there can be no excuse for failure to obtain an accurate history and to perform a careful physical examination in each patient prior to operation.

It becomes clearly evident, then, that it is of greatest value to the surgeon and anesthetist to be constantly on the alert for cases which may be predisposed to postoperative cerebral accidents; they must always bear in mind that such possibility exists. The surgeon who states that he does not see such accidents in his practice is either doing very little surgery or does not recognize the true nature of the accidents when they occur.

TREATMENT

The treatment of postoperative cerebral accidents is discouraging. An ounce of prevention in these cases is worth many pounds of treatment. Too often the changes produced by oxygen lack are irreversible but milder forms of cerebral complications, namely, the confusion states, the postoperative psychoses and even many of the muscular disturbances may often disappear as the general condition of the patient improves.

Evidence of the existence of some type of cerebral accident dependent upon anoxia may occur while the patient is still in the operating room. At other times such evidence in the form of postoperative psychosis, convulsions or hemiplegia does not become manifest until several hours or days after the operation. Their occurrence calls for the use of the same measures which are important in the prevention of cerebral complications, namely, the maintenance of blood volume, the support of the circulatory system and the administration of adequate oxygen. Blood volume is best restored by transfusion of whole blood or blood serum, while oxygen may be administered by any of the methods commonly in use, preferably by mask or tent.

When cerebral accidents occur, knowledge that they are central nervous system manifestations of general circulatory insufficiency should guide treatment. Many

patients are harmed rather than helped by treatment aimed at overcoming hyperactivity of the central nervous system by the use of morphine, barbiturates or spinal drainage. Such treatment only leads to further circulatory depression.

SUMMARY AND CONCLUSIONS

1. Emphasis has been placed on the importance of recognizing the type of case which is a potential victim of cerebral postoperative complications.

2. Measures designed to prevent such accidents have been discussed.

3. The treatment of cerebral complications has been discussed and the injudicious use of morphine derivatives and barbiturates is condemned.

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The prognosis in poliomyelitis is more favorable in children under three years and in adolescents over fifteen years. Our chief objective at the present time is early diagnosis and prompt and repeated injections of large concentrated potent doses of convalescent serum into the veins.

THE TUBED PEDICLE GRAFT IN FACIAL RECONSTRUCTION

ITS SUPERIORITY WHEN SUBCUTANEOUS LOSS IS PRESENT

CLIFFORD LEE WILMOTH, M.D., F.A.C.S.
PITTSBURGH, PENNSYLVANIA

A DISFIGUREMENT of the face or neck often results in social ostracism and economic distress. The plastic surgeon has the opportunity to restore the disfigured area or areas to normalcy so that activities, social and professional, may again be resumed. The desire to be normal in appearance is not of recent origin. It is as old as history. The economic necessity to be normal in appearance is being more and more emphasized. The economic competition of our present age demands physical fitness. Disfigurements of the face are handicaps which cannot well be overcome in the competitive life of our present time. The plastic surgeon in his choice of tissue transfers can correct the disfigurement and give to the unfortunate individual a new outlook on life.

The development of the tubed pedicled graft has solved many problems in plastic surgery about the face. Plastic surgery about the face entails a more exacting choice of operation and more precise technic than do similar reconstructive operations elsewhere on the body. Particularily is this so when the subcutaneous tissues have been destroyed or must be excised because of existing pathological changes.

When there has been no loss of subcutaneous tissues, the free full thickness graft may be found an easier and a fairly satisfactory covering for an excised disfigurement. However, for those facial disfigurements associated with a subcutaneous loss of tissue, the tubed pedicle flap offers far more satisfactory results.

CASE REPORTS

CASE 1. The patient was a man fifty-eight years old who two and a half years previously developed a lesion of the left inframandibular region which was diagnosed as malignant. He was subsequently given a series of *x*-ray treatments. Following the *x*-ray therapy the tissue broke down leaving a chronic ulceration which had refused to heal under various methods of treatment. At the time he was referred to my office he had a superficial ulceration of the skin 3 cm. in diameter. The surrounding skin over an area of 8 cm. was firm, adherent, fibrotic and atrophic. Surrounding this fibrous skin area was a margin of small telangiectatic vessels. The impression was an *x*-ray burn. A section was removed from the edge of the ulcer to rule out any possibility of recurrent malignant ulceration.

The case illustrates the economic difficulties of even a relatively minor disfigurement. This man was a salesman. He had experienced difficulty obtaining any position because he constantly had to wear a dressing over the ulcerated area. When he did obtain a position, it was usually only a short period of time until he would be discharged. He found it more and more difficult to obtain an interview and to hold the attention of the prospective customer while wearing a dressing on his face. Because of the economic struggle he was forced to seek relief by plastic surgery.

Under local novocaine infiltration anesthesia the tube flap was made extending from the tip of the acromium to the pectoral area. After an interval of three weeks, under general anesthesia the avascular fibrous tissue was excised until normal vascular tissue was reached. The pectoral end of the tube was then cut free from its attachment and the distal half of the tube was opened out. It was sutured into the defect. The tubed graft healed in position as illustrated. It has now established a local circulation and could now be freed from its tube attachment.

The patient, however, refuses to have the remainder of the tube removed. He fears that there might be a recurrence of the malignancy. In such a case the area could be excised and the remainder of the tube sutured into the defect.

The presence of the tube causes no inconvenience. It is entirely covered by his clothing and in case of further need a good sized piece of skin will be ready for grafting.

Fig. 1. Case 1. *X*-ray burn following malignancy of left inframandibular region. A graft three by eight inches in size has been made into a tubed graft, extending from the shoulder to the pectoral area. After three weeks it is ready for transferring to the recipient area.

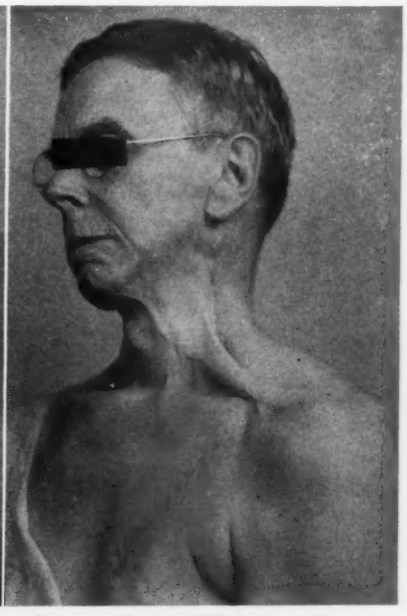

Fig. 2. Case 1. The *x*-ray burn with its adjacent avascular fibrous tissue has been excised. The pectoral end of the tubed graft was cut across and the distal half of the tube opened and sutured in the defect. The unused portion of the tube could now be excised and the medial edge of the graft resutured for improved appearance.

Such burns as this require a different principle of treatment from those of the usual skin defect. The roentgen rays destroy malignant and normal cells by causing a proliferation of the endothelium of the blood vessels in that area. The local tissues become ischemic. The free skin grafts will not survive because of the lack of blood supply to the area and the resultant diminished nutrition. Under such conditions the graft should always be a pedicled one with its own sufficient blood supply.

Case II. The patient was a seventeen year old girl. She stated that when she was a small child she fell against a red hot heating stove. The skin over the left side of the face and forehead was so burned that it was said "the skin stuck to the stove when she was pulled away from it." The result was an asymmetry of the face with adherent scarring, chiefly of the left cheek. The skin had not only been destroyed but also the subcutaneous fat so that the scarred skin was adherent to the bony structures. Ectropion of the lower lid was present. The eyeball was not injured.

It was believed that although the defect might be repaired by a free skin graft, because of the necessity for replacement of subcutaneous tissue the tube graft offered a far greater improvement, so that the more complicated procedure appeared advisable. The simpler type of operation using a full thickness free graft would have improved the condition. The free flap would have had less subcutaneous replacement than was required. It is very probable that it would have been followed by pigmentation to a varying degree over the grafted area. For these reasons the tubed graft was advised.

The tube graft differs from all other forms of delayed skin flaps in that it prevents the formation of granulation tissue

and subsequent scar tissue on its deep surface. As a cosmetic flap it cannot be surpassed where large quantities of skin are required. It can be transferred from a distance with readiness and safety by temporary attachment to an intermediate host such as the hand or forearm.

Fig. 3. Case 11. As a small child the patient fell against a red hot stove. The result was a loss of subcutaneous tissue as well as the disfiguring scars. The right cheek, supra-orbital area and the forehead were scarred.

The chief disadvantages of the tubed graft is the time factor and the necessity for multiple operations. The financial aspect of necessity enters into any procedure involving multiple periods of hospitalization. This may seem to the less experienced surgeon an urge to shorten the period between stages, which inevitably leads to disappointment and greater delay. While the periods of hospitalization may often be safely shortened for economic reasons, the length of time between the stages must not be shortened without danger of loss. It is easy to misjudge the variability of a flap even when the time interval appears correct. As a rule an interval of three weeks between the time of making of the tubed flap and its transference is sufficient. The transference of one end to the hand, and later to the face and again the severence of the unused portion of the tube will require a period of nine weeks. If the entire tube is to be used, another two weeks' period will be required.

TECHNIC

The flap is cut according to pattern but on the liberal side so that later when the flap is thinned to conform to the adjacent structures, the margins may be excised and a more satisfactory suture line obtained. This again can best be done in stages. At each stage the opposite sides of the graft are raised, thinned and resutured. This results in decided improvement in the cosmetic results.

As in all types of skin grafts to exposed areas of the body, color and texture match are very important. An exact pattern is helpful and the pattern should be placed so that Langer's lines conform in both the donor and recipient areas. Before the tube is formed a mesh gauze is placed over the area which is to be replaced by normal skin. With one of the dye antiseptics an outline is made on the gauze. The gauze is then placed over the donor site and the entire area painted with the dye. The tube to be formed may not exceed the required width and when it is later reopened it may more easily be made to conform to the defect, particularly if the defect is irregular in outline.

The tubed flap should be handled with the same care as a free full thickness graft. It should not be pinched with forceps in any stage of its transfer. Sutures or hooks are much safer for transferring the flap and holding it in position for suturing.

The tubed flap first described by Filatoff in 1917 but popularized largely by Gillies and others, has become more and more generally used in plastic surgery.

In making the tubed flap two parallel incisions two and a half to three inches in width, depending upon the size desired, are made through the skin and subcutaneous tissues. The direction of the parallel incisions should be parallel with the general course of visible veins or over the area in which known arterial branches are present. An infra-red photograph of the donor area may be a help in determining the exact direction and abundance of the superficial veins, which may not be demonstrable by the usual examination. Some surgeons have set a length of eight inches as the maximum for the tubed flap. The viability depends not on exact measurements but in the evident arterial supply and the venous return. The tube flap can be made longer in the thin individual than in a fat person. The horizontally inclined vessels are all cut across by the parallel incisions so that the flap receives its entire blood supply only from the longitudinal vessels entering each attached end. With the loss of the lateral circulation, the longitudinal blood supply increases during the three weeks' interval between first and second stages. At the end of three weeks the tubed flap should be viable, so that when one end is severed and attached to its recipient site or to an intermediate host site, the circulation from the one end is sufficient to nourish the entire tube until it again develops an additional longitudinal circulation through the end which was transferred. This again will require a period of about three weeks.

Fig. 4. Case II. A tube of skin measuring three by eight inches was made below the right breast.

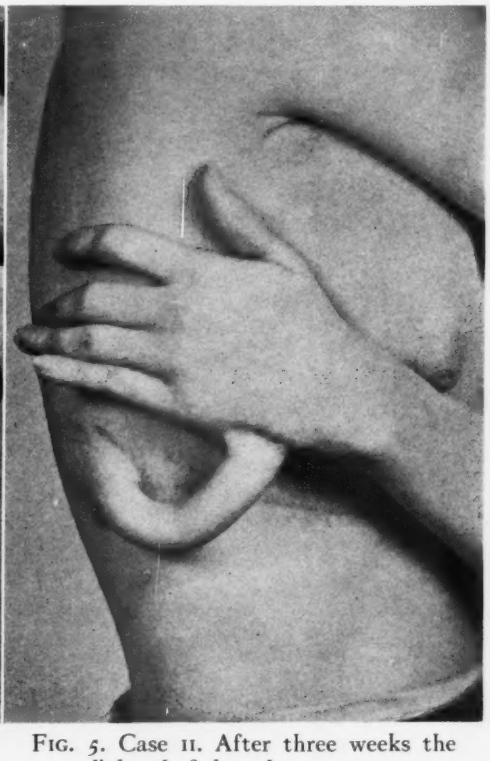

Fig. 5. Case II. After three weeks the medial end of the tube was cut across. An incision was made along the ulner side of the left hand and the end of the tubed graft sutured to this incision.

When the tubed flap must be transferred to a distant part of the body, the hand or wrist may be safely used as the intermediate host. The part of the hand or wrist decided upon will depend upon the location of the recipient area and the greater facility with which one portion of the hand is best suited to the recipient area. As in Case II the ulnar side of the hand was decided upon as the resulting scar would be in a relatively inconspicuous location and when the palm of the hand was placed along the side of the

head it was not in a cramped position, and the tube could be attached to the recipient area without any interference from the

Fig. 6. Case 11. After another period of three weeks the other end of the tubed graft is cut loose from the body. The disfiguring scar of the left cheek was excised. The distal half of the tube was opened out and sutured in the defect. The arm and body was enclosed in a plaster cast.

hand and without undue torsion of the tubed flap.

When greater areas of skin are required than can be furnished by an eight inch tube of skin, the tube may originally be left attached in the middle as well as at the ends during the first stage. This middle attachment is then sutured to the hand at the end of three weeks. Then after a second three weeks' interval the two ends are freed and attached to the distant recipient area.

The donor sites will be decided upon by the requirements of the recipient area. For a woman's face the area should be hairless and the texture of the skin should be similar. If large areas of skin are the only requirements for the individual case, a large tube can be satisfactorily made when it extends from the lateral thoracic region to the inguinal region. Because of the direction and abundance of the blood vessels a longer tubed flap can be safely made or the dura-

Fig. 7. Case 11. Two years later. The graft has been thinned and resutured in stages. The supra-orbital scars were excised as well as those of the forehead.

tion of the first stage interval for a short flap may be safely shortened.

There are a number of additional points of importance to be observed in making a tubed graft. Hemostasis in the tube itself must be absolute. Bleeding vessels should be ligated with fine silk or catgut. Capillary oozing is controlled by hot packs. Any excess of fat should be trimmed away before the suturing is started so that in suturing the tube no undue tension nor constriction of any part of the tube will result. A suture placed near each end of the proposed tube will facilitate handling and suturing of the remainder of the tube. The sutured tube may then be retracted to one side by a gauze tape while the donor area is prepared for closure. By undermining the skin of either side the donor area can usually be closed without great difficulty. If upon closure of the donor area undue tension on the skin appears evident, subcutaneous sutures of silk or catgut will

relieve the tension on the skin sutures. If hemostasis has been carefully observed, no drain should be used in the donor area. The donor incision is covered with sterile gauze and the tubed flap is wrapped in vaseline gauze. Pads are placed on either side of the tube so that pressure on the tube itself is prevented. The additional dressing should not produce any mechanical interference with the circulation of the tube. The dressings are held in position either with loosely fitting adhesive tape or a gauze binder.

Very little postoperative care should be required following the first or second stage. Seldom will a dressing be required before the fifth or sixth postoperative day, if upon inspection the attached ends of the tube are normal in appearance. If one end of the tube appears cyanotic, reddened or edematous, the dressings must be removed at once and a hematoma searched for. Gentle massage at frequent intervals may be useful in relieving temporary passive congestion, until a better circulation can be established. Technical failures in using the tubed graft are usually the result of ischemia. Poor judgment in the size and construction of the tube, too tight suturing of the tube and too early transference of one end to its new location are among the causes of ischemia. With proper attention to details the tubed graft offers superior possibilities for the restoration of the nose, ears or defects in skin and subcutaneous tissues of the face and neck.

While the duration of the entire series of operative procedures may cover what appears at first glance to be an unreasonable period of time, the results may well repay one for the additional period of hospitalization and disability. The periods of hospitilization for each stage are relatively short. In Case II all stages were carried out under local anesthesis. For the first stage five days of hospitilization were required, for the second stage two days' hospitilization. For the third stage four days, the fourth stage two days, and for the later stages of thinning and resuturing one and two days each were required. This is a total of eighteen hospital days, not a much greater period of hospitalization than for many of the common run of major surgical operations. The greater period of weeks of inactivity may seem prohibitive, yet it must be remembered that most of these patients for whom the tube graft is required because of the existing disfigurement have not been able to obtain very remunerative occupations, hence the loss in time diminishes in importance.

SUMMARY

The importance of the tubed graft cannot be overemphasized in reconstructive surgery of the face and neck.

Tubed grafts when properly performed result in excellent cosmetic improvement. Better results than can be obtained by the use of free full thickness grafts should compensate the patient for the greater period of disability.

This combination of relatively simple operations under local anesthesia should relieve the patient of a disfigurement which has been a source of mental anguish and an economic handicap for years.

The multiple-stage tubed graft procedure while covering a long period of time, actually requires little more hospitalization than the average major surgical procedure, and the loss in time is usually of relatively little economic importance to the patient.

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RABIES*

S. W. MOORE, M.D.
Assistant Attending Surgeon, New York Hospital
NEW YORK, NEW YORK

RABIES probably causes fewer human deaths and yet is associated with greater fear and hysteria than any other known disease. While in the United States there occur less than one hundred deaths each year from rabies—for ten years from 1924 to 1933 there were 746, an average of less than 75 per year—the average deaths from appendicitis is 15,000 and about 34,000 people are killed in automobile accidents each year.

Recent publications[1,2,3] have raised the question as to the effectiveness of the Pasteur prophylactic treatment and as to whether this therapy is necessary.

Because of the confusion which exists in the minds not only of the laity but of the profession concerning the value of treatment and the proper care of animal bites, it would seem wise to review certain facts about rabies and its effective prevention:

There is no report of spontaneous recovery in man with rabies.[4]* There is no report of man contracting rabies after being bitten by a rabid human. Recoveries in dogs, rabbits and guinea-pigs have been noted and in certain instances in which the disease was proven. Every kind of animal is susceptible to the disease, even birds may contract it. Rabies is perpetuated in civilized communities almost exclusively by the domestic dog and, to a small extent, by wild animals of the dog family.

Prevalence. Rabies exists practically all over the world. It has, however, never been known in Australia due to a rigid quarantine on dogs. It has not been reported in Denmark, Norway and Sweden for more than fifty years. In the United States in 1890, there were 143 deaths in thirty states; in 1933 there were sixty-five deaths. In England during 1895, 672 cases were reported in dogs with twenty human deaths. By improving the muzzling law this was cut down in three years (1898) to seventeen cases of rabies and two human deaths. In 1903, the disease was completely wiped out in England; however, due to the transportation of dogs across the Channel during the World War by aeroplanes, rabies reappeared in 1918.

Incubation. The period of incubation is long and varies from fourteen days to one year or more. The prolonged periods of incubation denote latency. The average period in dogs is twenty-one to forty days, while in man it is forty days. In children incubation seems to be shorter as it also is after bites on the face. The length of time between the bite and the onset of symptoms depends upon the amount and the virulence of the virus and the nature and site of the wound, especially with reference to its nerve supply. It requires about fifteen days to induce active immunity to the disease by means of the Pasteur preventive treatment.

Virus. The virus occurs principally in the saliva and in the central nervous system. It may be present in the saliva four to twelve days before the dog shows symptoms. It is, therefore, sufficient to watch a dog that has bitten a person for fourteen days and if no symptoms of rabies appear in the dog during this time, there is no danger of the disease having been transmitted and the Pasteur prophylactic treatment is unnecessary. Practically the danger from a bite during the preclinical stage is very slight.

The virus enters the system through the broken skin and follows the course of the

* In this discussion we have drawn freely from "Preventive Medicine and Hygiene" by Rosenau.

* From the Department of Surgery of New York Hospital and Cornell University Medical College.

nerve trunks from the site of injury to the spinal cord and thence to the medulla and brain. The route is the same as in tetanus toxin.

Relative Danger of Bites. Bites on exposed surfaces are more dangerous than through the clothing because the saliva is wiped from the teeth by the clothing and little or none enters the wound. Bites upon the face are most apt to be followed by rabies. There is no authentic report of the transmission of the disease by a human bite, although this might be possible.

Prevention. To control the incidence of the disease and the fatal results, there are three methods: (1) treatment of the wound; (2) Pasteur prophylactic treatment and (3) control of the disease in dogs.

Treatment of the Wound. Wounds produced by the bite of an animal which might possibly have rabies should at once be cauterized with fuming or strong nitric acid. Cabot reports that he saved 91 per cent of guinea-pigs from the disease by cauterizing the bite with nitric acid after twenty-four hours had elapsed. Rosenau finds that practically all guinea-pigs can be saved by the prompt application of nitric acid, that its effectiveness decreases with time, but that it is partially protective up to forty-eight hours. No other cauterizing substance gives equally good results.

Pasteur prophylactic treatment was first announced on December 6, 1883. The principle of treatment rests on producing an active immunity by means of a modified virus which has been attenuated by drying. The fixed virus contained in the spinal cord of rabbits dead of hydrophobia is emulsified and injected subcutaneously. This classic method of Pasteur has been modified in various ways in regard to the manner of attenuating the virus. The Semple method is fast becoming the method of choice on account of its simplicity and apparent effectiveness. In this method the spinal cord and medulla is made ineffective by carbolic acid. The dose is 2.5 cc. injected into the subcutaneous tissues of the abdominal wall once a day for fourteen days. All doses are the same regardless of age, sex, severity of the bite or location of the wound.

Care during Treatment. It is not necessary to keep the subject in bed. He may go about his usual occupation. Fatigue, cold, emotion, stress, trauma and alcohol should, however, be avoided. It was found that custom's officers returning to the Siberian borders after prophylactic treatment for wolf bites, showed an unusually high mortality which seemed to be due to exposure to cold. The disease has been known to occur after the shock of falling in cold water and in alcoholism.

IMMUNITY

Duration. Immunity appears about two weeks after the treatment and lasts a varying period of time. The treatment, therefore, should be repeated after a second bite.

Nature. The nature of the immunity is not clear. That it is not an antitoxin is certain.

Degree. The treatment usually affords definite protection but it sometimes fails. The antigenic value of the material used is open to question in the failures.

Contraindications. There are none.

Indications. (1) If the dog is mad, begin at once with treatment. (2) If the dog shows symptoms suggestive of rabies, begin treatment at once. (3) If the dog is not mad, observe the animal closely for fourteen days and if no symptoms develop there is no danger of the person bitten contracting the disease. (4) If the dog cannot be identified, the rule is to advise treatment except in regions known to be free of rabies.

CONTROL OF RABIES IN DOGS

Muzzling. The consistent muzzling of all dogs for two years would practically exterminate rabies.

Quarantine. A quarantine, to be effective, should be imposed for six months due to the long period of incubation.

The Stray Dog. It is largely the stray dog which keeps rabies in existence.

DIAGNOSIS

The diagnosis of rabies is based on (1) symptoms, (2) the presence of Negri bodies in the central nervous system, (3) lesions in the peripheral ganglia and (4) animal inoculations.

The symptoms may be very suggestive, but cannot be depended upon for diagnosis. The course of the disease may be divided into three stages: (1) Premonitory stage, (2) a stage of excitement, and (3) a paralytic stage.

The first two stages may be absent or transient. All rabid animals become paralized before they die. Dogs suffering from a furious rabies have a tendency to run long distances (even twenty-five to fifty miles) often biting and inoculating large numbers of animals and persons en route.

Negri bodies are found especially in the Horn of Ammon and the cerebellum; they vary from 1 to 3 micra in size, are usually round or oval, strongly eosinophilic and occur within and without the nerve cells; they sometimes contain nucleii.

The lesions in the peripheral nerves consist of round cell formation.

The final diagnosis rests upon animal experimentation. A small quantity of an emulsion of the medulla or pons of the suspected animal is placed under the dura mater of a rabbit or guinea-pig. The diagnosis by this method requires such a long time that it is of no practical value in deciding whether or not to administer the Pasteur treatment. However, in a critical case the positive evidence provided by this method is final.

Leach, the Field Director of the Rockefeller Foundation State Board of Health of Montgomery, Alabama,[5] has shown that microscopic examination of the brain for Negri bodies is not entirely dependable. He found in 1,032 animal brains, 338 positive, 690 negative and four questionable for Negri bodies. Of the 338 positive brains, three were negative on mouse inoculations and of the 690 negative for Negri bodies, eighty-three (12 per cent) showed rabies on mouse inoculation. Of the four questionable on microscopic examination three were positive by inoculation.

IS IT NECESSARY TO TREAT BITES FROM RABID ANIMALS?

Not every person bitten by a rabid animal develops rabies. No recent figures are available concerning the proportion of those bitten who received no prophylactic treatment and yet did not become ill with the disease. The statistics are difficult to analyze and now it is almost impossible to collect data of persons bitten by mad dogs and not treated. The mortality ranges from 6 to 51 per cent. (Table I.)

The importance of early treatment has been well shown by Park and Williams.[6] (Table II.) Here the mortality of 1–1000 in over 6,000 cases treated within five days, mounts rapidly to 1–30 in 313 cases treated after three weeks.

TABLE I
MORTALITY FROM BITES OF RABID ANIMALS WITHOUT PROPHYLACTIC TREATMENT

Author	No. Cases	Deaths	Mortality Per Cent	Ratio
Leblanc	...	...	16.6	1–6
Park and Williams	...	...	10.0	1–10
Paltauf	...	...	6–9	
Faber	339	27	8.0	1–12
Kurrimoto	...	...	17.0	1–6
Babers	995	139	15.0	1–7
Horsley	...	...	15.0	1–7
Tardieu	855	399	46.0	1–2
Bouley	266	152	51.0	1–2

This is also shown in the League of Nations report (Table II) in which the mortality is doubled in those cases treated after fourteen days.

The eight analytical reviews of Reports from Pasteur Institute[7] on the results of antirabies treatment, cover 758,182 persons who have received the treatment with 2,743 deaths, a mortality of 0.36 per cent, or one in 300 persons. In this group, 10 per cent of biting animals were proved rabid by

experiments, 13 per cent certified by medical or veterinary physicians, 73 per cent suspected to be rabid and 4 per cent not suspected to be rabid. To date this is the most comprehensive report available and will be drawn upon largely in the following discussion.

Table II
MORTALITY IN RELATION TO DELAY IN STARTING TREATMENT

Author	Days Delay	No. Cases	Deaths	Percentage	Ratio
Park and Williams	1–2 days	3,406	3	0.088	1–1000
Park and Williams	3–4 days	2,541	2	0.077	1–1000
Park and Williams	5–6 days	809	1	0.124	1– 800
Park and Williams	1 week	4,602	26	0.560	1– 200
Park and Williams	2 weeks	961	16	1.660	1– 60
Park and Williams	3 weeks	313	10	3.190	1– 30
Park and Williams	Untreated	.....	...	10.00	1– 10
League of Nations.	0–4 days	78,633	211	0.27	1– 400
League of Nations.	5–7 days	21,972	44	0.20	1– 500
League of Nations.	8–14 days	13,877	34	0.25	1– 400
League of Nations.	Over 14 days	7,551	43	0.57	1– 200

The severity of the bite is very important. It is well known that deep, multiple or savage bites are more dangerous than superficial ones. In 43,343 persons with deep bites, 251 died, a mortality of 0.58 per cent or 1–200. In 63,346 persons with superficial bites there were eighty-one deaths, a mortality of 0.13 per cent or 1–750, while in 13,928 persons with no visible lesion there were no deaths. (Table III.)

The intervention of clothes also is important. Of 82,538 bites on bare skin 297 died, a mortality of 0.36 per cent or 1–300. While in 29,862 bites through clothing, twenty-five died, a mortality of 0.08 per cent or 1–1200. The reason a bite on bare skin is three times as deadly is the fact that clothes remove saliva from the dog's teeth. (Table IV.)

Table III
RELATION OF SEVERITY OF BITE TO MORTALITY

Type of Bite	No. Patients Treated	Deaths	Mortality	Ratio
Deep.....	43,343	251	0.58	1–200
Superficial.....	63,346	81	0.13	1–750
No visible lesion.	13,928	0	0	

Table IV
INTERVENTION OF CLOTHING

	No. Patients Treated	Deaths	Mortality	Ratio
On bare skin....	82,538	297	0.36	1–300
Through clothing	29,682	25	0.08	1–1200

Another point of utmost importance is the position of the bite. There were 5,943 bites on the head with 109 deaths, a 1.83 per cent mortality. On the arm 46,591 bites caused 133 deaths, a mortality of 0.3 per cent; on the trunk 4,906 bites caused six deaths, a 0.1 per cent mortality and on the leg 58,630 bites caused eighty-four deaths, a mortality of 0.1 per cent. (Table V.)

Table V
LOCATION OF BITE

	No. Patients Treated	Deaths	Mortality	Ratio
Head.....	5,943	109	1.83	1–50
Arm.....	46,591	133	0.29	1–300
Trunk.....	4,906	6	0.12	1–1000
Leg.....	58,630	84	0.14	1–1000

The seriousness of the head bite is pointed out by all writers and the lower mortality of trunk and leg bites is considered largely due to the fact that these bites are usually through clothing. The arm bites carry three times the mortality of trunk and leg bites. This is explained by the fact that most arm bites are on the hand which is usually uncovered. It is interesting to note that arm bites are three times as dangerous as trunk and leg bites and also bites on bare skin are three times as dangerous as bites through clothing.

Again in Table VI all cases are grouped according to the biting animal, the dog being by far the most frequent offender, although the wolf and jackal are more dangerous. This is due to the savage character of wounds made by the latter two animals.

TABLE VI
RELATION OF SPECIES OF BITING ANIMAL TO MORTALITY

Animal	No. Patients Treated	Deaths	Mortality	Ratio
Dog	106,907	267	0.25	1–400
Cat	5,531	4	0.07	1–1500
Wolf	1,019	83	8.15	1–15
Jackal	23,601	377	1.60	1–60
Solipeds	735	1	0.13	1–700
Ruminants	2,116	0	0	
Human	1,007	0	0	

Of interest is the observation of 1,007 bites by rabid humans without a death; also 2,116 bites by ruminants without a death.

Rabies in Birmingham.[1] Denison, the Director of Laboratories, and Dowling, the health officer, have done a very excellent job of preventing human rabies in Birmingham. However, they write a confusing paper and are apt to mislead the reader by their conclusions. They have mixed the figures for the city, county and state so thoroughly that it is difficult to extract those of the city alone.

Birmingham has a population of 250,000 of which 40 per cent are negroes. The dog census shows 20,000 for which ownership is established, the actual number being much higher as it is obviously impossible to count ownerless strays.

During the ten years, 1929 to 1939, a total of 1,495 animals received a positive laboratory diagnosis of rabies; 5,206 persons received antirabies vaccine and three persons died of the disease. Two of the persons dying were negroes. They say that "negroes are too unconcerned and too uninformed to suspect rabies." There is no case reported in which a person bitten by a rabid dog was not treated. They give no figures for the relative number of white and negro persons treated in Birmingham. Yet they say that "there is little relation between mortality from rabies and the administration of antirabies vaccine, for among the highly exposed untreated (negro) population, fatalities are no greater than among the highly exposed treated (white) population and such rare fatalities as do occur are equally distributed among the treated and untreated."

TABLE VII
DEATHS FROM RABIES IN ALABAMA, 1922 TO 1936
Animals, positive diagnosis of rabies 9,282
Persons treated 34,864

Deaths	Mortality	Ratio
42	0.06	1–2000

	Deaths in Treated Cases	Deaths in Untreated Cases	Total
	21	21	42
White	16	14	30
Negro	5	7	12

This statement is made in the face of their figures for Birmingham which show 40 per cent negroes with twice as many deaths as the 60 per cent white population and without a single bite from a rabid animal which did not receive treatment.

On the basis of their observations they adopt a very sane regimen. They start treatment immediately for all bites above the shoulders or for multiple severe lacerations of the body or extremities and discontinue them in case the animal proves not to be rabid. In all other cases, treatment is started when the diagnosis has been established. They also cauterize the wounds with nitric acid. The purpose of their paper is to try to prevent some of the hysteria associated with dog bites and to limit treatment to actual bites or scratches made by the suspected animal.

Rabies in Alabama.[8] Many of the figures which comprise the paper mentioned above concerning rabies in Birmingham[1] are taken from one entitled "Rabies in Alabama."

During the fourteen year period from 1922 to 1936 in Alabama, 9,282 animals had a positive diagnosis of rabies; 34,864 persons were given antirabies vaccine and forty-two died of the disease, a mortality of 0.06 per cent or 1–2000.

Of the forty-two fatalities, twenty-one patients had received prophylactic treatment and twenty-one had received no such treatment. Twelve deaths occurred in negroes and of these seven had received no prophylactic treatment.

In twenty-six cases the site of the bite is mentioned; it occurred on the head in eleven, on the arm in eleven, on the trunk in one and on the leg in three.

It is interesting that although their discussion deals with not treating rabies, there were only twenty-two cases reported in the series in which bites from rabid animals were not treated by the Pasteur prophylactic method and all of these twenty-two persons died of rabies. (Table IV.)

*Rabies in New York City.** The cost of rabies prevention to the City of New York is around $100,000 annually.[9] Under a charter of the State of New York, the American Society for the Prevention of Cruelty to Animals is empowered to issue licenses for dogs and cats and to collect the proceeds.[9] During 1939 there were over 300,000 dogs licensed in New York City.[10] The income to the American Society for Prevention of Cruelty to Animals was $404,688.00.[10]

During the past ten years (Table VIII) there have been five deaths from rabies in New York City; two of the patients received no prophylactic treatment; in one, treatment was started twenty days after the bite and in one after three days. The fifth patient received treatment after 1 day.

* Statistics quoted from Official records of the Department of Health, Bureau of P. D.

CASE REPORTS

Case I. 1930. A child, aged twenty-eight months, was bitten under the eye by a stray dog which was never caught. The wound was carbolized by an ambulance surgeon and the mother instructed to go to the Board of Health to have the child treated. This she failed to do. Twenty-eight days later the child became quite sick and four days later was dead of rabies. Negri bodies were found. Incidentally, the child bit the nurse's finger for which bite treatment was given.

Case II. 1934. A girl, seventeen years of age, was bitten by her own dog on the left arm. The dog died next day. The wound was cauterized and the girl's father and the girl told that they should apply for prophylactic treatment; this they failed to do. She became ill fifty-one days later and died three days after the onset of her illness. Negri bodies were found.

Case III. 1934. A child of seven years was bitten in the face by the family dog. The wound was cauterized with nitric acid and the next day, prophylactic treatment was started. She received fifteen injections. Seven days after the last injection she became ill and died after four days of illness. Negri bodies were present in both patient and dog.

Case IV. 1936. An infant was bitten by a rabid dog on the street. Treatment was started twenty-four hours after the dog was proved to be rabid and three days after the bite. The wound was cauterized with fuming nitric acid and the infant received twenty-one injections of the Semple treatment.

Case V. 1938. A youth of seventeen years was bitten by his own dog which developed rabies. Treatment started twenty days after the bite. After ten injections the boy developed rabies and died in two days.

During the ten year period from 1930 to 1939 (Table VIII) there have been five deaths due to rabies in New York City. There were 593 dogs pronounced rabid and 598 persons bitten by dogs so proved. Of these 598 persons bitten by rabid dogs, 586 received antirabies treatment with three deaths, a mortality of 0.5 per cent. There were fifteen persons who did not receive antirabies treatment following a bite proved to be by a rabid dog. Of these fifteen, two died, or a mortality of 13.3 per cent.

In addition there were 1,256 persons in contact with rabid dogs but not bitten by them. Of this number 826 received treatment and 430 were not treated. There were no deaths in this entire group.

In all 17,199 persons were given the Pasteur preventative treatment in New York City during the last ten years with three deaths due to rabies.

Paralysis. Paralysis occurs occasionally following prophylactic treatment of rabies and may be fatal. This complication seems to be a mild or modified type of rabies, but there is doubt concerning its cause. It is suggested that it may be due to injection with the fixed virus; or possibly toxin or both. Paralysis may follow injections of nerve substances derived from a normal animal. Serious paralysis is a rare complication; in mild form it doubtless occurs more often than is indicated by the records. It affects adults chiefly, young children almost never.

Its incidence varies greatly, but is about one in 10,000 persons treated, with about one in four of these resulting fatally.

In 756,307 persons treated in the League of Nations series, 139 accidents are reported with forty-one deaths.

All students of the subject are convinced that the Pasteur prophylactic treatment saves many lives by preventing rabies in persons bitten by mad dogs, but agree that it should not be administered when unnecessary.

TABLE VIII

RABIES IN NEW YORK CITY, 1930 TO 1939*

Year	1939	1938	1937	1936	1935	1934	1933	1932	1931	1930	Total
Deaths due to human rabies	0	1	0	1	0	2	0	0	0	1	5
Number of rabid dogs (proved)	58	86	68	27	20	44	26	18	56	100	593
Persons bitten by rabid dogs (proven)	52	93	75	42	20	77	42	10	42	146	598
Persons treated after bite by rabid dog (proved)	49	92	73	41	20	73	42	10	42	144	586
Deaths	.....	1	.....	1	.....	1	.....	.....	.....	.....	3
Persons not treated after bite of rabid dog (proved)	3	1	2	1	.....	5	.....	.....	.....	3	15
Deaths	.....	.....	.....	.....	.....	1	.....	.....	.....	1	2
Persons in contact with rabid dogs	321	397	275	48	35	51	37	12	40	40	1,256
Persons treated	219	245	144	37	22	34	37	11	39	38	826
Persons not treated	102	152	131	11	13	17	0	1	1	2	430
All persons given Semple treatment (including stray dogs, etc.)	2,722	2,504	1,988	1,774	1,529	1,555	1,209	1,193	1,292	1,443	17,199
Deaths	.....	1	.....	1	.....	1	.....	.....	.....	.....	3

* The above statistics are from "The Official Records of the Department of Health, Bureau of Preventable Diseases."

SUMMARY

Rabies is largely of importance because of the fear and hysteria associated with it. It is perpetuated in civilized communities almost exclusively by the domestic dog. The disease is always fatal in humans. It can be prevented entirely by controlling the disease in dogs which can be accomplished by effective muzzling. Wounds should be treated by nitric acid and the Pasteur prophylactic treatment instituted at an early date. Paralysis following this treatment may occur and at times is fatal, therefore, unnecessary treatments should be avoided.

CONCLUSIONS

Wounds produced by the bite of a rabid animal or one which might be rabid should be cauterized with fuming or strong nitric acid.

Indications for prophylactic treatment are: If the dog is mad, begin treatment at once; if the dog shows symptoms of rabies,

begin treatment at once. If the dog is not mad, observe the animal closely for fourteen days and if no symptoms develop, there is no danger of the person bitten contracting rabies. If the dog cannot be identified, advise treatment except in regions known to be free of rabies. There is sufficient danger of paralysis following prophylactic treatment to make it inadvisable to administer it unnecessarily.

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MUSCLE BEHAVIOR FOLLOWING INFANTILE PARALYSIS

HERBERT E. HIPPS, M.D., F.A.C.S.
Crippled Children Hospital
MARLIN, TEXAS

THIS study of muscle behavior following infantile paralysis was undertaken to determine primarily whether it is true or not that paralyzed muscles will gain in strength if put at rest in a relaxed position. This dictum has been commonly accepted as a truth, yet our general observation over a five-year period of time has thrown considerable doubt about this in our mind.

This critical analysis of muscle grades on patients that have been treated in various ways has, therefore, served to give the desired information and has revealed other interesting and informative data.

Eighty-eight cases were used in this study. These patients had been treated in the Crippled Children Hospital for the last thirty months. Their ages varied from six months to twenty-five years. Some patients were seen early after contracting the disease, others were seen late. The type of prior treatment varied from none at all to excellent care in some other institution.

Muscle gradings on transplanted muscles were not used in this study because of the difficulty of accurately comparing the strength of the muscle in its two different positions.

Before and after gradings on muscles about a stabilized foot were not used because of the change of leverage produced in these muscles when a foot is displaced backward through the subastragaloid joint in doing the arthrodesis.

Certain muscles were not used in this study, for example, the quadratus lumborum, since it is a muscle difficult to grade accurately as other muscles may hide or overlap its action. Only those muscles that are easily graded have been used to insure greater accuracy in this study. In all the analyses except one, the only patients used were those receiving physiotherapy and bracing, or rest and bracing, or some combination of these. The type of physiotherapy given was pool work and exercise in the gymnasium under the supervision of a graduate and well trained physiotherapist.

TABLE 1

Age	9				18			
Duration before	5 Wks.				6 Mo.			
Duration tr. here	Adequate				1 Yr.			
Treatment here	Pool—Brace				Pool—Brace			
Treatment before	None				None			
Name, etc.	D. S.				C. L.			
	First Grade		Last Grade		First Grade		Last Grade	
Muscles	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.
Quadriceps	o	o	P−	P−	T	P	P+	F−
Inner hamstrings	o	o	T+	T+	T	T+	P	P+
Outer hamstrings	o	o	T+	T+	T	T	P	P+
Gastroc-soleus	o	o	T+	T+	o	T	o	o
Common flexors	P	o	P+	o	o	o	o	o
Flex. hall l.	P	o	P+	o	o	o	o	o
Common extensors	o	o	T+	o	o	o	o	o
Ext. hall l.	o	o	T+	o	o	o	o	o

Large charts were first made as in Table 1 which shows a part of one of these preliminary charts. Here was recorded the age of the patient, the duration of the disease before he came here for treatment, the type of treatment received here and the type of treatment he had received previously. The treatment here was simply classified as to whether it was considered adequate or not. Periods of physiotherapy of less than four months were not considered adequate. This, of course, does not necessarily mean that all of the physiotherapy must have been taken in the hospital, as some cases with minimal involvement may learn their exercises well enough that they may be carried out at home under the mother's

supervision after she had been taught accurately how to carry on with them. If a patient was kept here an insufficiently long period of time or if we knew that his exercises were not properly carried out at home as we had directed, his treatment was called inadequate. The type of previous treatment before coming to the hospital may have been good in some other institution or may have consisted only of the application of braces, or there may have been none at all. Such is recorded in the chart.

Table II

Name	No. Muscles Showing No Improvement	No. Showing Slight Improvement	No. Showing Moderate Improvement	No. Showing Excellent Improvement	No. Muscles Involved	Improvement, Per Cent
K. D.....	11	1	9	16	37	62.1
V. C.....	0	3	5	16	24	85.2
E. D.....	9	4	5	0	18	26.4
J. H.....	13	11	1	1	26	17.3

In the column below, the muscle grade was recorded when the patient first came under our observation; in the column just to the right of this was recorded the grade when the treatment was finished or when this chart was compiled. This gives then the first and last grade on the muscles that have been treated.

The muscle grading system used is as follows:

$$\frac{0\text{—Trace—Poor} \mid \text{Fair—Good—Normal}}{G}$$

The grader often used a plus or a minus after a grade if it seemed helpful or desirable, so that a muscle may grade poor plus instead of poor, thus giving a slightly more flexible range of possible grades.

An attempt was made to establish a standard method of determining the percentage of improvement made by each patient. This was worked out by considering arbitrarily that if a muscle gained more than one grade, for example, gained from *poor* to *fair* plus or *poor* to *good*, it was considered as having made *excellent* recovery. If a muscle gained only one grade, it was considered as having made *moderate* improvement; if it made less than one grade, it was considered to be only a *slight* improvement; and, of course, if no improvement was found, it was graded as *zero*. The total number of paralyzed muscles for each patient was recorded in one column. The number showing the different degrees of improvement as determined above was recorded in appropriate columns as in Table II. From this then the percentage of improvement per case was worked out. *Excellent* was considered arbitrarily as 100 per cent improvement, *moderate* as 75 per cent improvement, and *slight* as 25 per cent improvement, and of course, *zero* as 0 improvement. The number of muscles in each column multiplied by the percentage of that column and all of these added together and divided by the number of muscles involved gave the average percentage of improvement that each particular patient made. Any muscle losing ground under treatment would naturally detract from these percentages but was not considered here, as so very few muscles lost ground under physiotherapy that it was considered as a negligible factor. This method of deriving the percentage of improvement is possibly subject to some question as it was empirically developed, but it seems to be as accurate as can be

Table III

Name	Age	Duration before Tr.	Duration Tr. Here	Tr. Here	Previous Tr.	Improvement, Per Cent
M. W..	13	6 mo.	Adequate	P. and Br.	Adequate	70.8
A. W..	2	1 mo.	Adequate	P. and Br.	None—walking	69.5
J. T...	4	1 yr.	Adequate	P. and Br.	None	44.7
H. H...	18	1 yr.	3 wks.	P.	P. and Br.	6.6
M. G..	3	1 yr.	2 mo.	P. and Br.	None	5.0
J. W...	12	4 mo.	Adequate	P. and Br.	None	48.5
K. D...	2	3 wks.	1 yr.	P. and Br.	None	62.1
A. D...	17	several yrs.	Inadequate	P. and Op.	None	21.2
E. C...	6	7 mo.	2 yrs.	P. and Br.	None	9.4
F. D...	19	7 wks.	6 mo.	P.	None	43.6

obtained for this study since all cases were graded identically. It should be kept in mind that this was not a percentage improvement in regard to the patient's ability to walk or perform other functions; it was simply a percentage improvement in the strength of the muscles he had involved. For individual muscle improvement, therefore, this does seem to be a very accurate method of measurement and estimation of the percentage of improvement.

Table III shows part of the final master chart from which all subsequent deductions and observations were compiled.

FIG. 1. Improvement by age groups.

FIG. 2. Improvement based on type of treatment.

RESULTS OF ANALYSIS

The patients were first divided into three age groups: (1) Age six months to six years; (2) six years through fifteen years; (3) sixteen years up.

In the youngest age group the patient is not often co-operative in properly carrying out his exercise. The other two age groups are co-operative. The first two age groups, however, deal with growing muscles and the latter group with muscles that have ceased their normal growth. Figure 1 shows the relative degree of improvement of muscles in these three age groups. It was interesting to note that the age group six through fifteen years showed the greatest percentage of improvement. This might be expected when one considers that these patients had growing muscles and also co-operated fully in carrying out their treatment. In compiling these charts on age groups, two months was considered as the dividing line between long duration before treatment and short duration before treatment, and good previous treatment in these cases meant either early splinting in the proper position or early physiotherapy.

Two hundred eighty-seven muscles that graded *poor plus*, *fair*, and *good* made *excellent* improvement in 87 per cent of the cases. Two hundred seventy-six muscles that graded 0, *trace*, and *poor* showed only *slight* or no improvement in 90 per cent of the cases. This is an interesting observation since it shows that muscles that have been paralyzed a long time and grade only 0 or *trace* or *poor* will not be benefitted by prolonged rest nor physiotherapy, while muscles grading *poor plus*, *fair*, and *good* can be expected to improve sufficiently so that physiotherapy will be justified.

Twenty-five miscellaneous patients who received adequate treatment made an average improvement of 47.5 per cent. Twenty-one patients receiving inadequate treatment made a general improvement of 20.6 per cent. This may seem to be a peculiar and perhaps worthless observation, yet it does suggest rather strongly that treatment as we know it now, in the early stages of infantile paralysis, is definitely justified.

Twenty-three suitable cases were studied to try to determine the relative efficiency of the following three plans of early treatment. (1) Early complete rest; (2) early physiotherapy; (3) no particular early treatment.

By early treatment was meant the stage from the onset of the paralysis to the disappearance of all muscle soreness.

Patients in group one were treated by having the body or involved limbs put at complete rest in a neutral position in splints, frames, or in plaster casts to give complete rest in a relaxed position to the paralyzed muscles.

Group two patients received early physiotherapy. They were brought to the hospital as soon as the acute illness and febrile stage was over. The muscles were still sore. The limbs had already been or were immediately put in proper splints and were kept in these splints at complete rest except for one interval each morning when the patient was carefully transported to the pool without muscular effort on his part. He was then given careful light massage and permitted to use, or to attempt to use his involved muscles. Extreme care was taken not to allow the patient to overdo the exercise nor to become fatigued.

Group three is composed of a small number of cases which were seen early, but these patients did not remain for treatment and they simply did about what they wanted to do at home. These were graded early and again later on so that two muscle grades were available.

In all of these cases except group three, the treatment must have been considered as adequate to be included in this table.

Group two, receiving early physiotherapy, showed 68.5 per cent improvement, group one 33.8 per cent, and group three 31.1 per cent improvement. (Fig. 2.)

It has long been thought that partially paralyzed muscles that are put at complete rest in a relaxed position will gain in strength in the large majority of cases.

This was considered as particularly true in muscles that have been under tension or stretched by a deformed limb, for example, a partially paralyzed quadriceps femoris on a limb with a knee flexion deformity

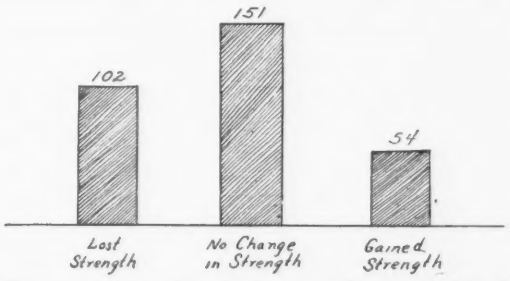


Fig. 3. Three hundred seven long paralyzed muscles treated by rest.

theoretically should gain in strength when the limb is straightened out and the quadriceps put at rest.

To check this assumption and to determine as accurately as possible the "improvement expectancy" of muscles so treated, was the primary purpose of this paper.

Three hundred seven muscles that had been paralyzed for two years or more were graded before and after being immobilized in a relaxed or neutral position.

Most of these were foot and leg muscles and most were immobilized because of an operation such as a foot stabilization, posterior capsulotomy on a knee or some other such procedure that necessitated the application of a plaster cast holding the limb in a neutral position. This period of rest varied from six to twelve weeks. Muscles that were stretched in the correction of the deformity, such as contracted hamstrings in a knee flexion deformity, were not used in this study.

This analysis showed that of the 307 muscles, 102 lost strength, 151 remained the same, and only fifty-four gained strength. (Fig. 3.)

The postoperative muscle check made immediately after the removal of the cast invariably showed a loss in muscle strength. There was a gradual regaining in their strength, however, until at the end of about three or four weeks they had reached their maximal gain, and it was this latter grading that was used in this analysis.

Further analysis of the group found that those muscles relaxed by correcting a bad deformity usually lost in strength, while those not associated with a bad deformity did not lose strength, but for the most part remained the same.

The following example will clarify and illustrate more explicitly the previous statement:

A patient having a calcaneous foot had four common toe flexors that graded good or normal in strength. The foot was operated upon and put up in a position of equinus for six weeks. The operation was a transplantation of the tibialis anterior to the heel cord and the toe flexors were not damaged or even touched during the operation. After removal of the plaster cast, they graded only trace and did not subsequently regain that strength. When this foot was forcefully pushed upward into dorsiflexion, the four toe flexors then contracted powerfully. This seemed to demonstrate that the muscle belly of the toe flexors had not lost strength itself, but that its tendon was so relaxed by the new position of the foot that when contraction of the muscle occurred, it simply took up the slack and was not able, therefore, to produce a pull at the point of insertion. The muscle had accommodated itself to the calcaneous position where the toe flexor tendons ran down and around the medial malleolus and then back up to the toes. When the foot was placed in equinus, the distance between tendon origin and insertion was considerably shortened, leaving a slack tendon. Proper intrinsic muscle strength also depends on some constant "contraction tonus" in a muscle. This "tonus" was lost by relaxing the muscle in correcting the deformity, so that it actually graded much weaker than it formerly did. The contraction that did occur in this muscle belly was shorter in range and was ineffectual because it simply was only enough to take up the slack that existed in the new position. Simple disuse atrophy that occurred during the period of immobilization was likewise a factor that may be considered in explaining some of the loss in muscle strength.

The foregoing analysis has definitely shown that long paralyzed muscles put at complete rest in a relaxed position lost strength more often than they gained strength; hence, it was impossible to work out an accurate percentage estimate of expected improvement in these muscles following such handling.

A general comparison of the muscle groups involved in the original charts showed that leg muscles were more often paralyzed than arm or trunk muscles. Trunk muscles were more often involved than arm muscles. In the upper extremity the maximal involvement was most frequently in the deltoid shoulder group of muscles. In the lower extremity the foot and leg muscles more frequently showed the most severe paralysis. Foot and hip flexor deformities were the most common deformities of infantile paralysis. The tibialis anterior was the most common single muscle involved. The tibialis posterior was involved more often than the peroneal group of muscles. The knee extensors were more often involved than knee flexors. The opponens pollicis was the most frequently paralyzed intrinsic muscle of the hand.

SUMMARY

1. Muscles long paralyzed that were treated by rest in a relaxed position for six to twelve weeks lost strength much more often than they gained.

2. Muscles that graded *zero*, *trace*, and *poor* and had been paralyzed as long as three months showed no appreciable gain on physiotherapy treatment.

3. Muscles that graded *poor plus*, *fair*, and *good* showed a considerable and justifiable improvement with physiotherapy.

4. The age group six to sixteen years showed a greater improvement than younger or older groups.

5. Patients who received early careful physiotherapy showed much better muscle recovery than those treated otherwise.

OSTEOPLASTIC CRANIOTOMY

HUGH C. TRUMBLE, F.R.C.S.
Neurosurgeon, Alfred Hospital
MELBOURNE, AUSTRALIA

THE methods usually employed in the cutting of large osteoplastic flaps in the skull have many disadvantages which need not be discussed. The procedure to be described has been developed by the author and thoroughly tried out during the last ten years. It is based on the work of Souttar, but has certain advantages of its own and avoids some of the disadvantages inherent in Souttar's method. Special tools are used in dividing the bone, and in order to permit of their use, head rests capable of supporting the head firmly have been designed.

FIG. 1.

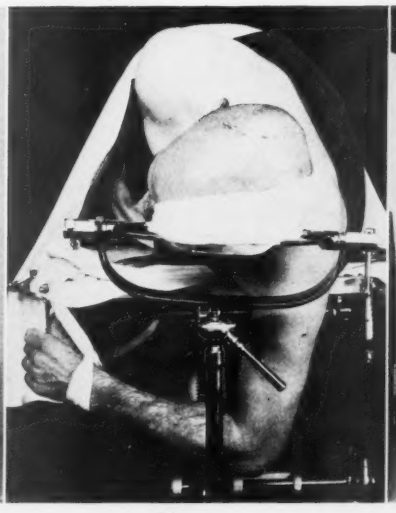


FIG. 2.

FIG. 3.

FIGS. 1, 2 AND 3. Showing how the head is supported in the specially prepared head rest. Note the arrangement of the patient's trunk and left arm. The photographs were taken a week after the removal of an astrocytoma in the right occipital lobe.

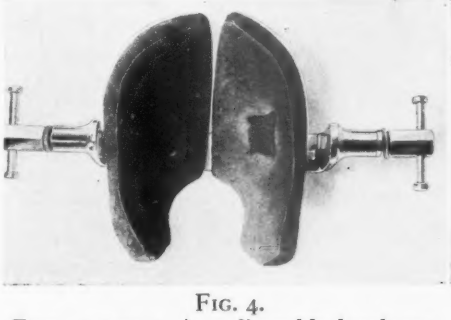


FIG. 4.

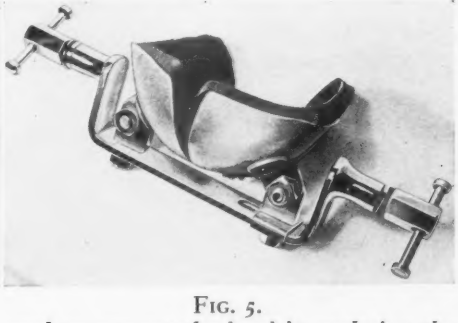


FIG. 5.

FIGS. 4 AND 5. An adjustable head rest, used to support the head in exploring the cerebellar fossa and sometimes when cutting occipital and frontal osteoplastic flaps.

HEAD RESTS

Unless the head is fixed efficiently, the craniotome cannot be used. The author's head rest consists essentially of a reinforced plaster of Paris facing, made after the manner of splints previously described by the author.[1] It is made, prior to operation,

on the patient's head and neck, in such a way that the field of operation is not encroached upon. The plaster facing is

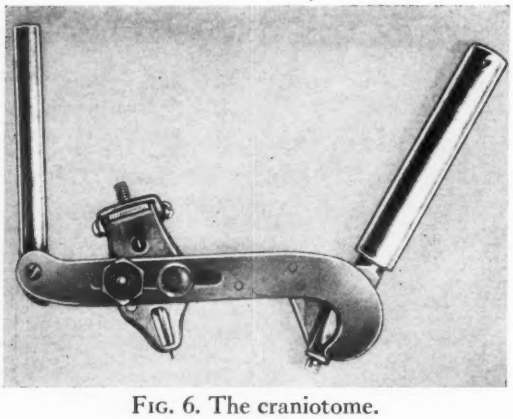


Fig. 6. The craniotome.

affixed by means of plaster cream to a metal ring, which in turn is carried on an adjustable attachment on the operating table. Universal movement is thus provided. The facing may be made in about ten minutes and saves a great deal of time at operation. (Figs. 1, 2 and 3.)

The rest as depicted in Figures 1, 2 and 3 permits the cutting of temporoparietal flaps. When it is desired to operate in the frontal or occipital regions, the plaster facing is made accordingly so as to leave the area in question free, and the patient lies either prone or on his back, as may be required. Sometimes, however, during the cutting of frontal or occipital flaps, an adjustable head rest is used which affords adequate though less efficient fixation. (Figs. 4 and 5.) The facing of the adjustable head rest is of spongy rubber, carried on two aluminium plates beaten to such a shape that they may be applied more or less closely to the great majority of heads or faces. By slackening off various nuts the plates are rendered movable and are applied snugly to the appropriate area of the patient's skull. The nuts are then tightened and the adjusted rest is placed in position in the mechanism of the operating table which provides all necessary movements. This head rest was designed in the first place to support the head during operations upon the cerebellum and is very efficient in this regard. Other than those described above, no head rest known to the author provides fixation sufficient to permit the use of the craniotome described below.

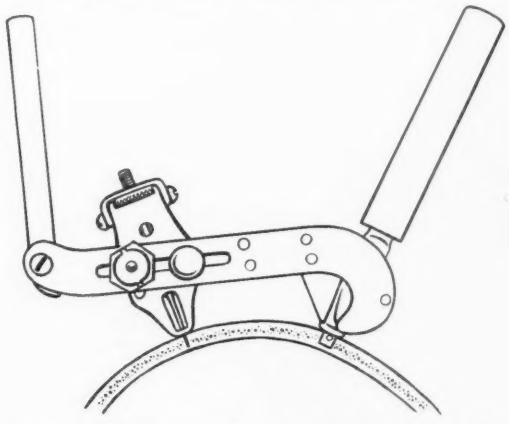


Fig. 7. Diagrammatic representation of the craniotome in position on the skull. The pin is carried in a hole in the bone, which is bored by the drill shown in Figure 9. The cutting tool has almost penetrated the bone, the remainder of which is broken in elevating the flap.

THE CRANIOTOME

The craniotome is operated by hand. (Figs. 6 and 7.) The pin around which the cutting tool swings is situated at the end of a heavy handle. An arm which carries the cutting tool is swung from the pin in such a way that the center of movement is just below the surface of the skull when the pin is placed in a hole drilled for its reception. (Fig. 7.) Thus if during operations the pin handle wobbles slightly in relation to the skull, the cutting tool does not vary in its track round the pin. The cutting tool is carried in a heavy metal block which may be moved along the carrying arm so that the surgeon may vary the distance from the pin to the tool. The angle which the block makes with the arm is also adjustable. The cutting tool is moved up or down in the block by turning a threaded collar through which the tool passes; thus the surgeon is able gradually to deepen the incision to any required extent.

The cutting tool is made from a piece of tool steel rod, one-quarter of an inch in diameter. At its upper end it is threaded and carries the adjusting collar already mentioned. At its lower end it is ground

so as to leave a flat section about three sixty-fourths of an inch thick and one-quarter inch wide. The end is ground much in the shape of a Hutchinson's incisor tooth. The flattened part of the tool slides through a slot in the nose of the carrying block, so that rotation is prevented. The tool cuts in either a clock-wise or an anti-clock-wise direction around the central pin.

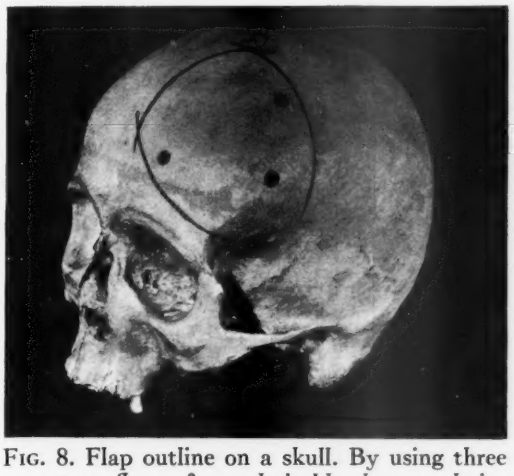


Fig. 8. Flap outline on a skull. By using three centers, flaps of any desirable shape and size may be cut. The lateral incisions pass over the temporal crest into the temporal fossa. The base of the flap, which is comparatively narrow, is broken through in elevating the bone.

METHOD OF USE

The instrument is used to cut arcs of a circle round the central pin. In practice the radius of the circle is set at about two and one-half inches. It is hardly ever desirable to make a full circular incision. By the use of three centers, flaps of any desired size and shape may be cut. An example is shown in Figure 8. In all cases the scalp is peeled from the skull in the selected area and the ends of the bone incision pass just below the temporal crest. The bone at the base of the flap is broken across beneath the temporal muscle when the flap is elevated. The flap remains attached to the muscle.

TECHNIC

The patient is anesthetized and then placed in position on the operating table. The head rest is adjusted and the body of the patient is fixed so that it cannot move. This is very important, and a good deal of apparatus has been designed to ensure proper fixation. The scalp is shaved and prepared *secundum artem*. The line of the incision is scratched on the scalp and should be about one-half inch outside the line of the proposed bone incision in the skull. The scalp is incised and reflected. Hemostasis is carefully effected. With a pair of dividers, the points of which are about two and one-half inches apart, three (usually) centers for the proposed arc incisions in the skull are quickly located and marked on the bone surface with a pointed steel instrument. An engineer's morse drill, of the same diameter as the pin of the craniotome and provided with a guard which prevents it from entering more than one-quarter inch below the outer surface of the skull, is used to bore holes for the reception of the pin of the craniotome at the selected spots. (Fig. 9.) The boring of a hole is the work of but a few seconds. In the boring of many hundreds of holes the dura has never been damaged by this drill. The pin of the craniotome is placed in one of the holes. The cutting tool is set so as to project about one-sixteenth inch.

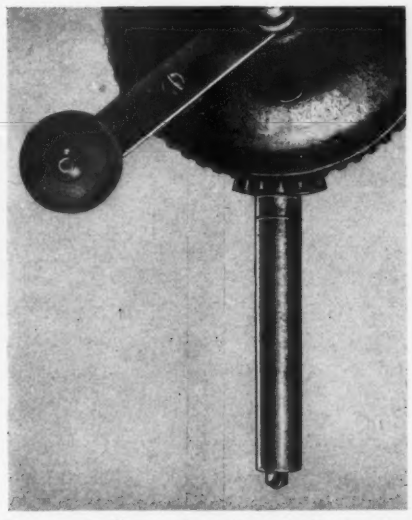


Fig. 9. Drill used to bore holes in the skull for the reception of the pin of the craniotome. The tube guard prevents the drill from entering too deeply and may be slipped off for cleansing purposes.

Assistants steady the head in the head rest. The surgeon with one hand sweeps the tool round the pin, which he steadies with the other hand. The tool is progressively adjusted so as to cut deeper and deeper. The approximate thickness of the skull is known from the appearance of the skiagraphs. The bottom of the incision can be clearly seen throughout the operation if a head light is used. When dark spots begin to appear, a probe is used to ascertain whether the bone has been penetrated in places. If so, the incision is deep enough. The remaining arcs are then cut. Four specially curved levers, similar to those used by Souttar, are then inserted into the incisions and the bone flap is elevated and turned back on the temporal muscle, which is attached near its base. More bone may be nibbled away in the temporal fossa if desired. Further procedures are undertaken in the usual way.

ADVANTAGES OF THE METHOD

The effort required to cut bone flaps of any size is not great. Unless unusual difficulties are encountered, such as excessive vascularity of the scalp, the dura may be exposed in from fifteen to twenty minutes from the time of commencement of the skin incision without any show of haste and with no neglect of hemostasis. If diploic vessels are cut across, bleeding is promptly, easily and safely checked by means of wax forced into the incision. The dura mater is not disturbed until the bone is elevated and the surgeon is in a position to control hemorrhage from its surface. The risk of wounding the dura or its vessels by the passage of guides beneath the skull is thus eliminated. The flap is neat and shapely, and when replaced is in firm bony contact with the edges of the defect in the skull. Bony union follows. Variations in thickness and texture of the bone of the skull make but little difference to the progress of the operation.

The craniotome is sturdily built and almost everlasting. It needs no attention beyond ordinary cleansing and perhaps sharpening of the cutting tool edges after cutting some dozens of bone flaps.

DISADVANTAGES OF THE METHOD

A special facing for the head rest is necessary for every case. This entails about ten minutes' skilful work before operation, but it is time well spent. Naturally, the plaster must be made correctly. Carelessness or clumsiness on the part of the surgeon in cutting too deeply might result in laceration of the dura mater and the brain. Such an accident could not occur unless the tool projected through the bone at least one-sixteenth inch, as the dura always gives way to some extent. As the bottom of the incision is visible for a moment at least after each sweep of the craniotome, penetration, which always occurs first at a few isolated points, should be noted long before the danger point is reached. It is confirmed by careful probing. The craniotome has been used exclusively in cutting about one hundred fifty bone flaps, and the dura mater has been slightly punctured in but two of the earlier cases. On the other hand, there is no doubt that in the hands of a clumsy or unskilful operator, damage might be done; but in such hands no method is safe.

SUMMARY

It is pointed out that the usual methods of cutting large osteoplastic flaps in the vault of the skull have serious disadvantages, many of which are avoided by the use of the method described.

Special tools for cutting the bone are described, as well as head rests which provide for efficient fixation of the head during operation.

The technic for using the apparatus is described.

Finally, the advantages and disadvantages of the method are discussed.

REFERENCE

1. H. C. Trumble. Made to order splints. The technique of construction and field of application. *Brit. J. Surg.*, 19: 292, 1931.

COLOR ILLUSTRATIONS

IN May we announced that from time to time we would present pictures of merit in color. Through the courtesy and generosity of Ciba Pharmaceutical Products, Inc., of Summit, New Jersey, who have supplied these illustrations, we are pleased to present to our readers a group of color plates portraying the major pathological conditions of the testicle and prostate.

The drawings were made by Dr. Frank Netter, the well known anatomical artist, and the copy was prepared by Dr. Samuel A. Vest, of the Department of Urology, University of Virginia Hospital.

We believe that these colored illustrations are particularly attractive and will aid in supplementing textbook descriptions of the normal prostate, benign prostatic hypertrophy, carcinoma of the prostate and malignant tumors of the testicle, and thus clear up any confusion which might exist in the minds of our readers regarding these pathological disorders.

T. S. W.

COLOR ILLUSTRATIONS

PROSTATE AND TESTICLE

PORTRAYAL IN COLOR OF THE NORMAL PROSTATE AND PROSTATIC AND TESTICULAR DISORDERS

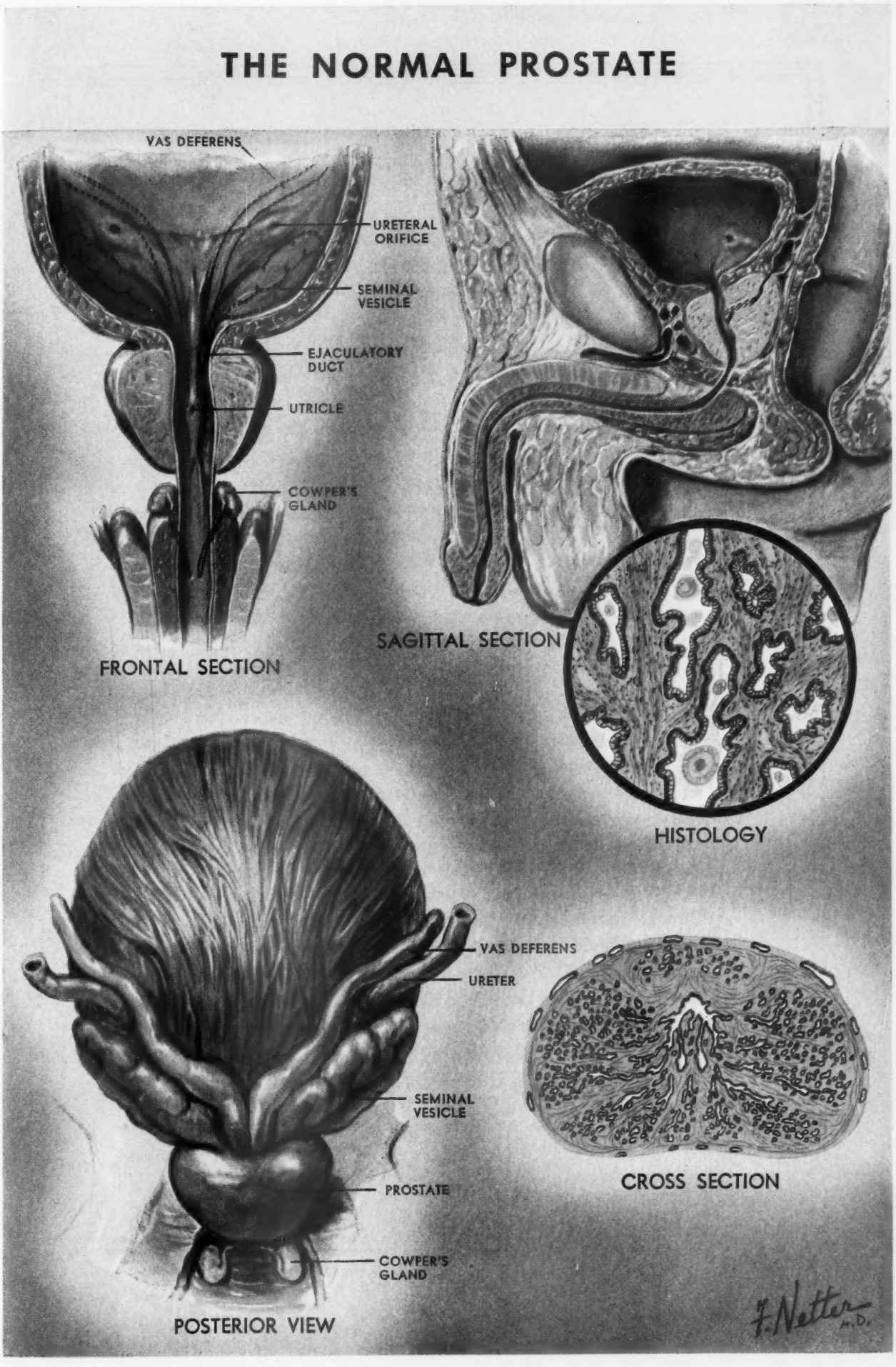
THE NORMAL PROSTATE

BENIGN PROSTATIC HYPERTROPHY

CARCINOMA OF PROSTATE

MALIGNANT TUMORS OF THE TESTICLE

THE NORMAL PROSTATE



THE PROSTATE

THE PROSTATE is the most important of the accessory sex glands. It is of particular clinical significance because of the frequency with which it becomes infected, hyperplastic and malignant. Because of the prostate's strategic location surrounding the posterior urethra and the vesical orifice, disease of this gland produces obstructive symptoms varying from the insidious and obscure to the most dramatic. The prostate develops as epithelial offshoots from the embryonic posterior urethra and is the homologue of the suburethral glands in the female, which, under certain conditions, grow to form a "female prostate." Until the age of puberty the prostate is impalpable and consists of a thin layer of immature glands around the urethra. The anatomical development and maintenance of secretory function depend upon a continuous, adequate supply of male hormone from the interstitial cells of the testicle. Castration results in subsidence of secretory activity and atrophy. In young men the gland weighs 20-odd grams with gradual involution and atrophy later in life except in instances when hyperplasia occurs.

This gland is composed of alveoli lined with columnar epithelium embedded in a relatively thick fibro-muscular stroma. They are drained by a system of branching ducts or tubules which empty into the posterior urethra. The complexity of the internal structure renders drainage difficult once infection has taken place.

The prostate is a gland of external secretion. The [illegible] is ejected by contraction of the smooth musculature within the prostate at the climax of the sexual act. The normal secretion consists of milky fluid containing lipoid granules, corpora amylacea, epithelial cells and spermine crystals. This alkaline secretion is believed to provide a medium concerned with the maintenance and activation of spermatozoa after ejaculation. There is evidence that the prostate's secretory activity can be stimulated or depressed by various drugs and hormones. The prostate also functions in an excretory capacity and excretes numerous substances such as alcohol, sulfanilamide, and other drugs in minute amounts.

BENIGN PROSTATIC HYPERTROPHY

BENIGN PROSTATIC HYPERTROPHY is of considerable general interest not only because of its local effects but because of the widespread systemic changes which sometimes result. There has been much speculation as to the nature of the enlargement, whether it is an actual tumor such as adenoma, fibro-adenoma, fibro-myoma, etc., and whether it is a result of inheritance, arteriosclerosis, infection, sexual activity, hormone imbalance, etc. The etiology is still obscure but has been the object of much endocrinological investigation during the past decade. The disease is primarily one of senescence occurring in approximately one-third of all males over 60 years of age. It has been said that some oriental races are not afflicted with this malady. Normal prostatic development and function depend upon the secretion of the male hormone from the interstitial cells of the testicles. The presence of functioning testicles is also necessary for the development of prostatic hyperplasia and no cases have been noted in eunuchs. Once the hyperplasia has developed there is little evidence that it is affected by castration. There is evidence that the secretion of male hormone (androgen) is decreased in old age. Female hormone (estrogen) has been found in the urine of normal men. This has led to a theory that the decrease of androgen in old age results in a preponderance of estrogen and that this imbalance is the cause of prostatic hypertrophy. Disturbances in the hormone secretion of other glands, especially the pituitary and adrenal, have been also considered as theoretical etiological factors.

Benign prostatic hypertrophy affects certain areas within the prostate and is not a diffuse hyperplasia of the entire organ. The portion which becomes hypertrophied most frequently is that adjacent to the urethra. The enlargement of these peri-urethral or submucous glands compresses the remaining normal or atrophic prostatic acini into a thin rim of tissue which is designated as the "false capsule." Several types of gross enlargement are usually encountered. Of these, the most frequent are: (1) bilobular (two lateral lobes), (2) trilobular (two laterals with median), (3) unilobular (median), and (4) circular or confluent enlargement at the vesical orifice. In lateral lobe hypertrophy the lobes are frequently joined at the internal vesical orifice by a posterior commissure. In median hypertrophy the lobe pushes its way into the bladder, while in the lateral type there is great elongation of the urethra before the lobes project into the bladder. The configuration of the lobes is readily recognized by cystoscopic visualization.

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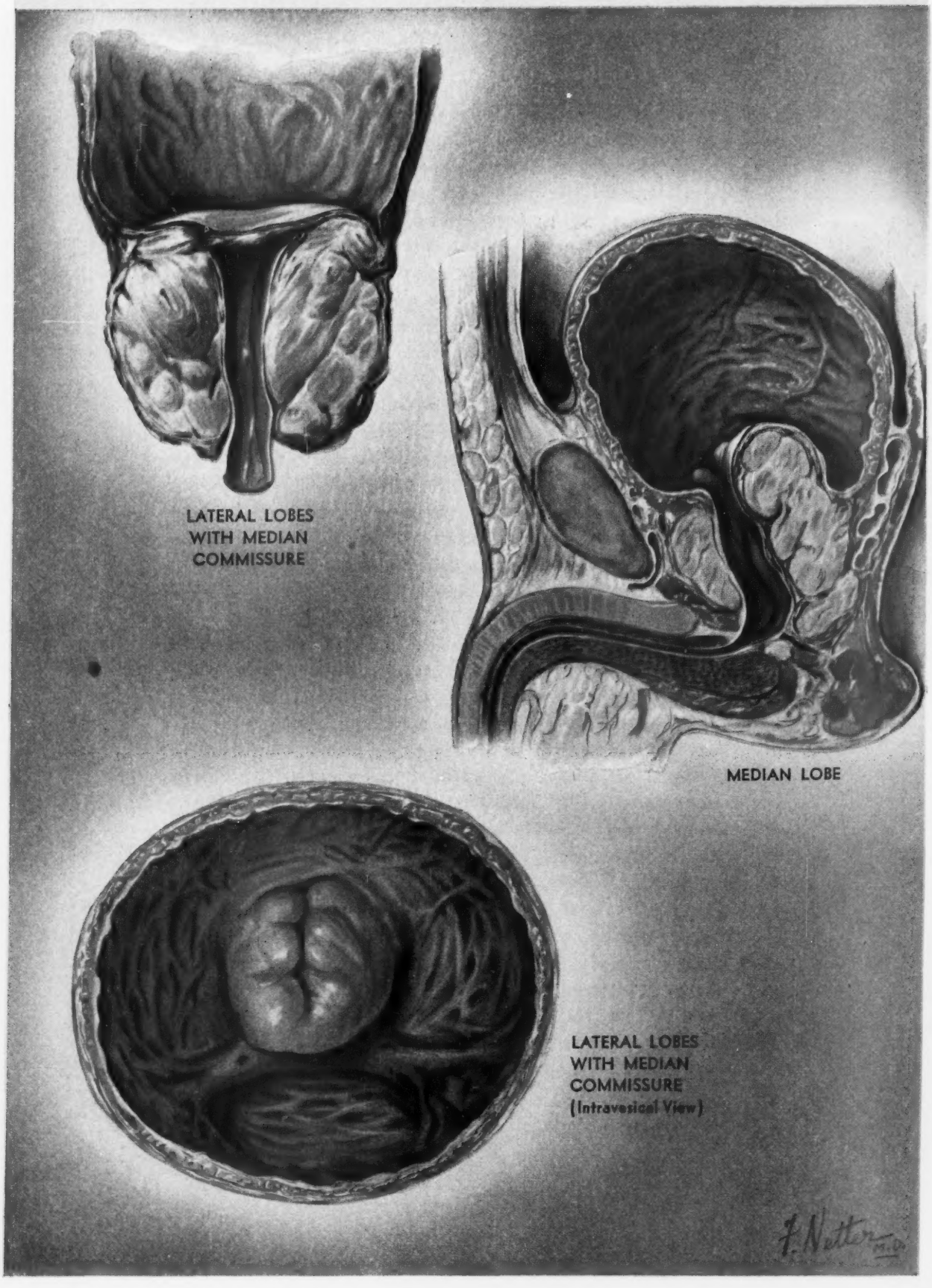
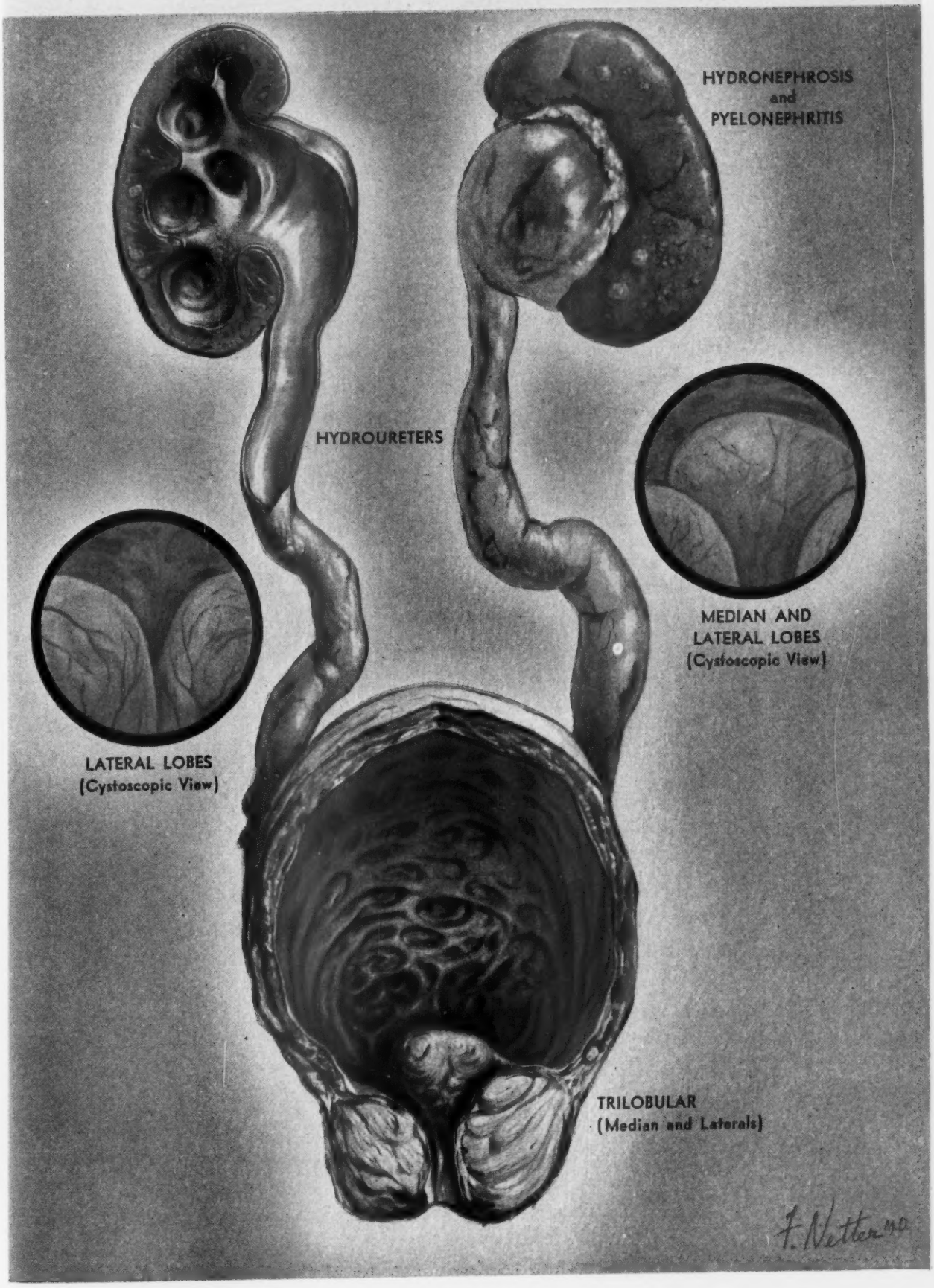
BENIGN PROSTATIC HYPERTROPHY



BENIGN PROSTATIC HYPERTROPHY



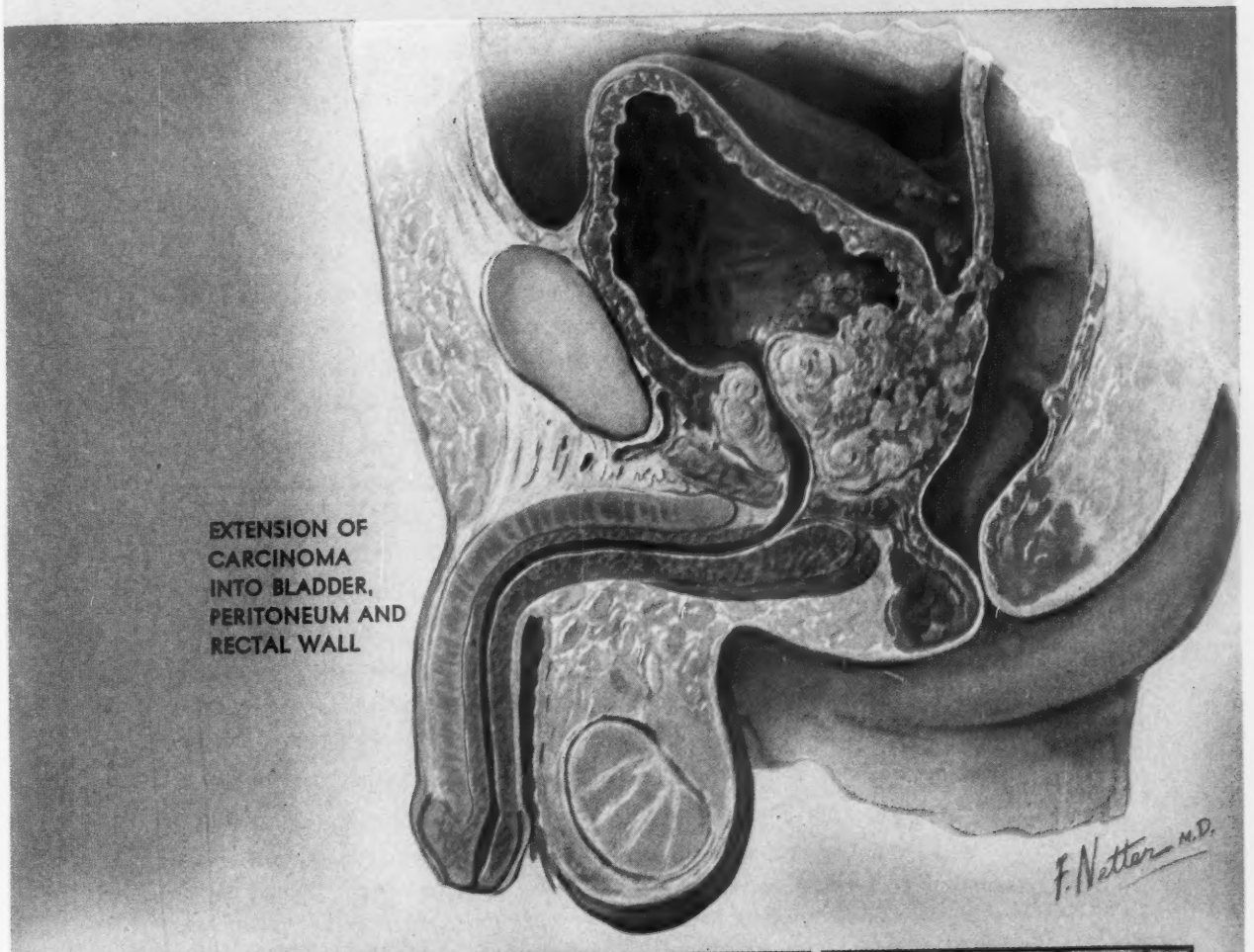
BENIGN PROSTATIC HYPERTROPHY

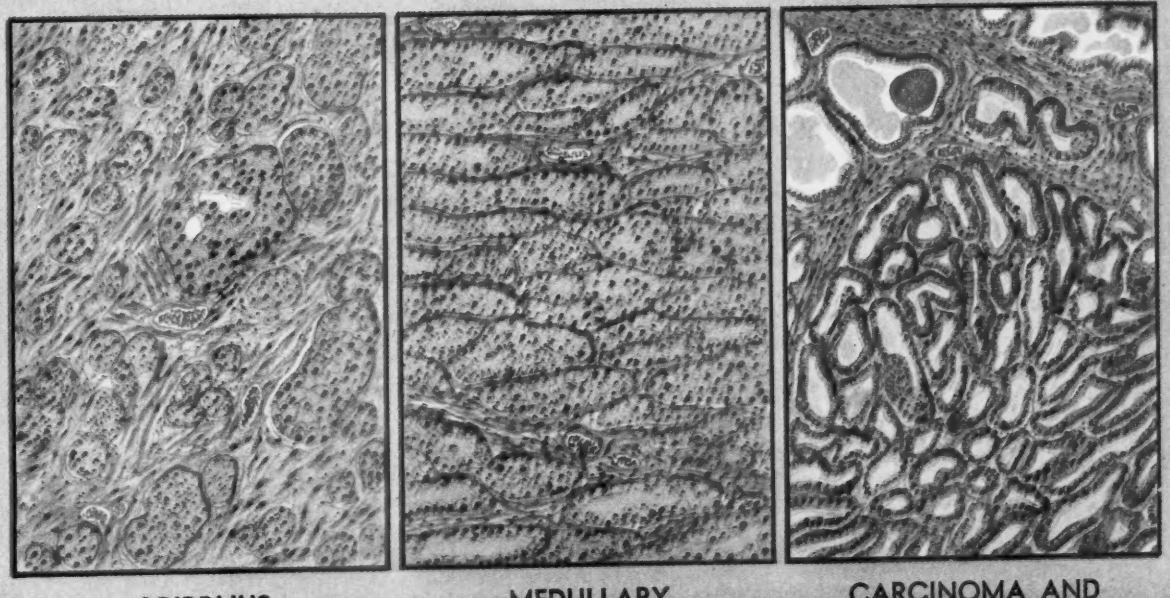
(Continued)

Such hypertrophied masses obstruct the posterior urethra and vesical orifice, seriously interfering with urination. This obstruction results in profound changes in the bladder, ureters, and kidney. Voiding requires increased pressure which leads to hypertrophy and thickening of the bladder wall. Trabeculation and cellules are common, and even large sized diverticula may be formed. The bladder finally reaches the limit of compensatory hypertrophy, after which there is gradual decompensation and dilatation with the development of residual urine. Rapid decompensation results in acute dilatation with complete urinary retention.

The most serious complication of prostatic hypertrophy is progression of the obstruction to the point where the back pressure is transmitted to the ureters and kidneys, producing hydroureter and hydronephrosis. If the obstruction is not relieved there is progressive decrease in renal function, resulting in uremia and death. The bladder may become secondarily infected following catheterization. This is often of grave significance, as it may lead to infection of the upper urinary tract. Acute pyelonephritis often precipitates fatal uremia, especially when hydronephrosis has already lowered the reserve function of the kidneys. Impaired kidney function complicated by acute retention and pyelonephritis is responsible for a considerable portion of the mortality in this disease. The mortality is low if the early symptoms are recognized and necessary treatment instituted before the onset of complications. It should be stressed that marked obstructive changes in the bladder, ureters and kidneys can occur with relatively mild symptoms.

CARCINOMA OF PROSTATE





SCIRRHUS

MEDULLARY

CARCINOMA AND
BENIGN HYPERPLASIA

CARCINOMA OF PROSTATE

CARCINOMA OF THE PROSTATE is present in about 25 per cent of all men who reach the age of 60, but because of its usual slow growth a majority of the victims do not die of the disease itself. Three clinico-pathological forms of prostatic carcinoma are recognized. First, the tiny occult carcinoma, which is symptomless except in rare instances when it metastasizes; second, carcinoma occurring together with benign hypertrophy; third, carcinoma unmixed with benign hypertrophy in which a variable portion of the prostate has become infiltrated. There is considerable variation in the microscopic findings in prostatic carcinoma but they usually reveal adenocarcinoma growing irregularly in abundant fibrous stroma. This scirrhus form results in the stony hard gland felt on rectal examination. Occasionally, the fibrous stroma is less plentiful, as in the medullary variety, which is soft on rectal palpation, rendering diagnosis difficult. Carcinoma of the prostate usually infiltrates the posterior aspect of the gland. In advanced cases there is an invasion of the posterior urethra, triangular ligament, seminal vesicles and at times extension into the bladder, peritoneum and rectum. The tumor frequently grows into the pelvis by way of the lymphatics and nerve sheaths. Extension to the pelvic bones and lumbar vertebrae is common.

The lack of symptoms in the early stages of the disease is striking, and metastases to bone sometimes produce the first symptoms. Obstructive symptoms are late manifestations and there is evidence that over 50 per cent of cases have metastases by that time.

The usual course of carcinoma of the prostate is slow and insidious, but rapid growth and widespread metastases are not infrequent. The hope of cure lies in early recognition before obstructive and metastatic symptoms develop. It should be diagnosed in the early stages while it is still a localized, hard nodule confined within the prostatic capsule. Routine, careful rectal examination in all men over 50 years of age is important and any suspicious induration discovered should be subjected to expert opinion.

MALIGNANT TUMORS OF THE TESTICLE

TESTICULAR NEOPLASMS form a very interesting group of tumors because of their cytological relationship to the primitive sex cells. Approximately 1 out of every 200 malignant tumors in the male originates in the testicle. It is essentially a disease of young adulthood with the maximum frequency of cases occurring between the ages of 20 and 40 years. It has been estimated that malignant tumors occur two hundred times more frequently in undescended testicles. Trauma and chronic irritation are thought to stimulate growth in a dormant tumor in many cases. The exact cellular origin of testicular tumors is still obscure. This has led to much controversy concerning the many pathological classifications. For present purposes the tumors are grouped according to their histologic appearance without reference to their complex genesis. Testicular tumors are almost all potentially malignant and benign tumors such as lipoma, fibroma, myoma and angioma occur so infrequently that they need not be considered. Tumors of the interstitial cells and adrenal rests which have been known to produce virilism in young boys are a great rarity. Malignant testicular tumors fall into two general pathological groups, the unicellular and the multicellular. Some authorities believe that the unicellular tumor is initially a multicellular tumor in which a great overgrowth of one cell type has taken place.

UNICELLULAR TUMORS are practically all epithelial and commonly known as seminoma, spermatocytoma, round cell sarcoma, etc., by various writers. They are homogeneous, lobulated, tumors of yellow-orange color. The cells are polygonal, have large nuclei, and may resemble spermatocytes. They vary in degree of malignancy, but in general grow somewhat more slowly and metastasize later than other malignant tumors. They metastasize through both lymphatics and veins.

MULTICELLULAR TUMORS are commonly known as teratomata, or mixed tumors. They are characterized by the presence of tissues derived from the three primary germ layers. Many types of tissue may be found in such mixed tumors, and the character of a given tumor is often determined by the overgrowth of tissue from any one of the three germ layers. For example, a tumor might be almost completely epithelial and even appear homogeneous. Four types of multicellular or teratomatous tumors are usually encountered.

Adult teratoma is relatively rare and makes up only 5 to 10 per cent of the multicellular group. It contains a predominance of adult tissue such as hair follicles, cartilage, bone, muscle, etc. There is a great variation in the gross appearance of the tumor but cystic structures are consistently present. It is the least malignant of the multicellular group and metastasis is a late development.

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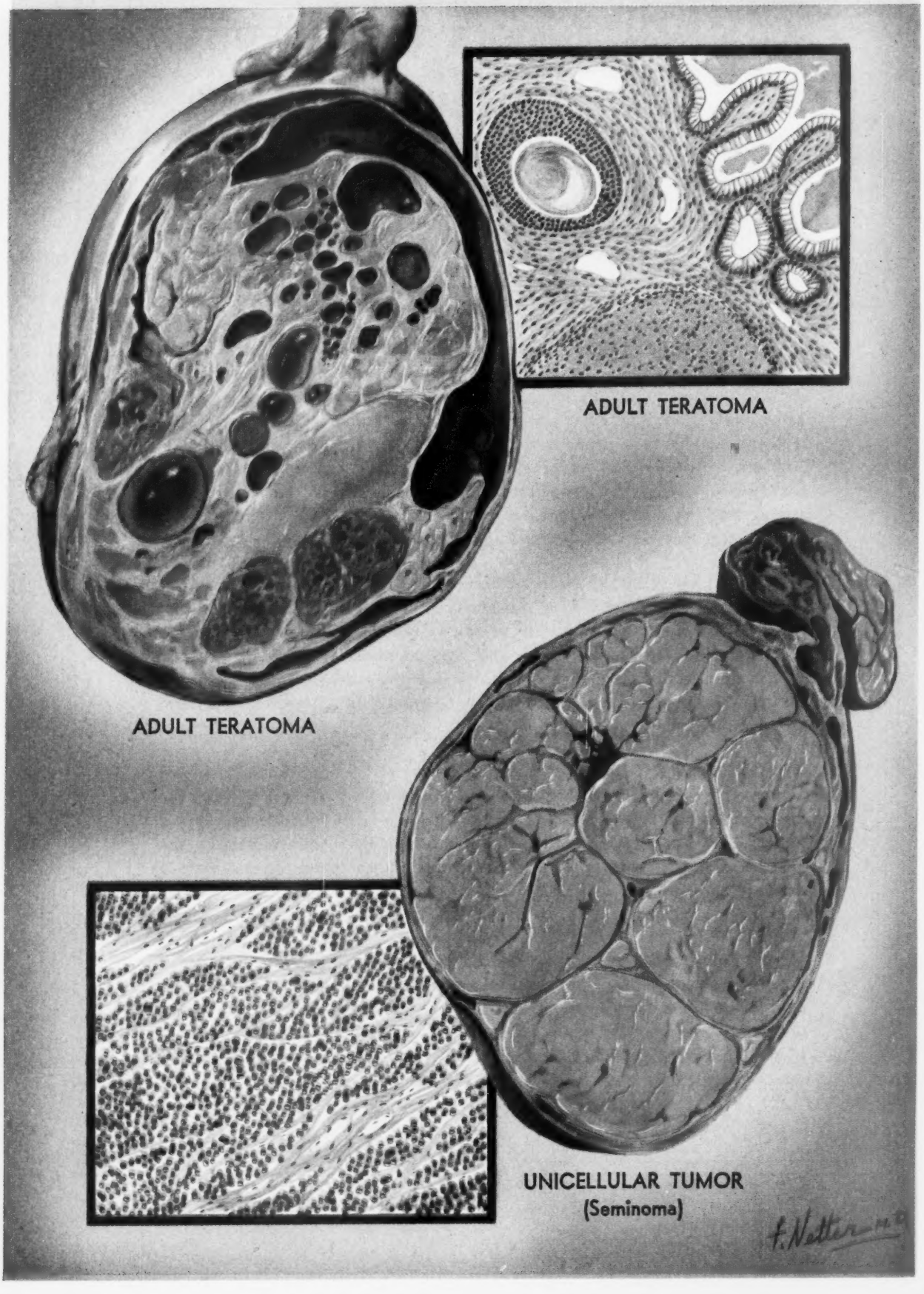
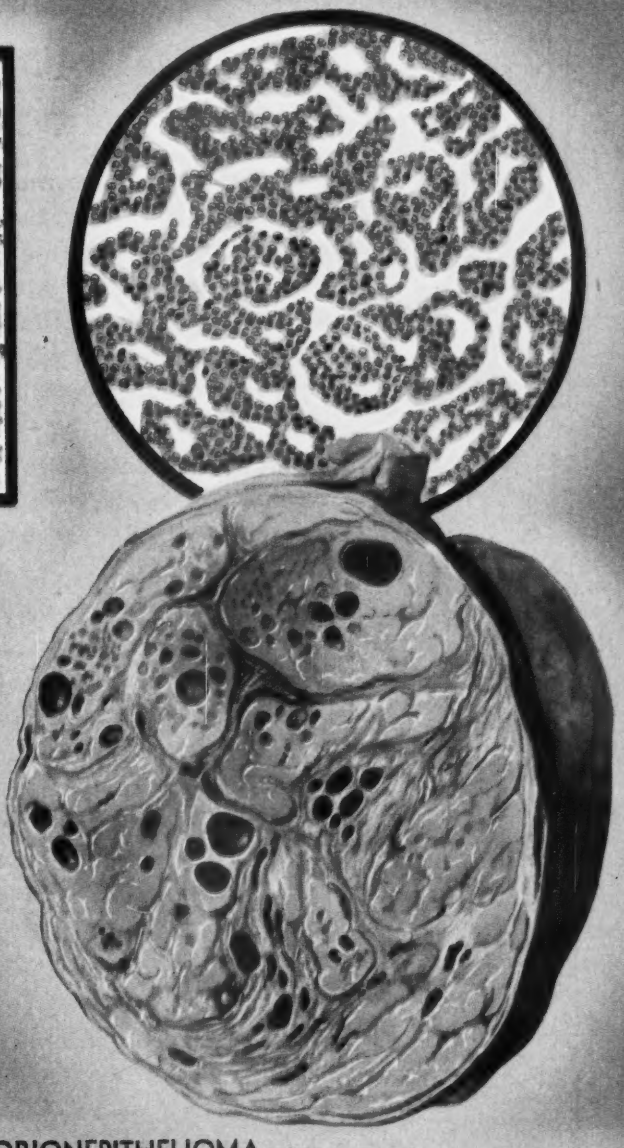
MALIGNANT TUMORS OF THE TESTICLE

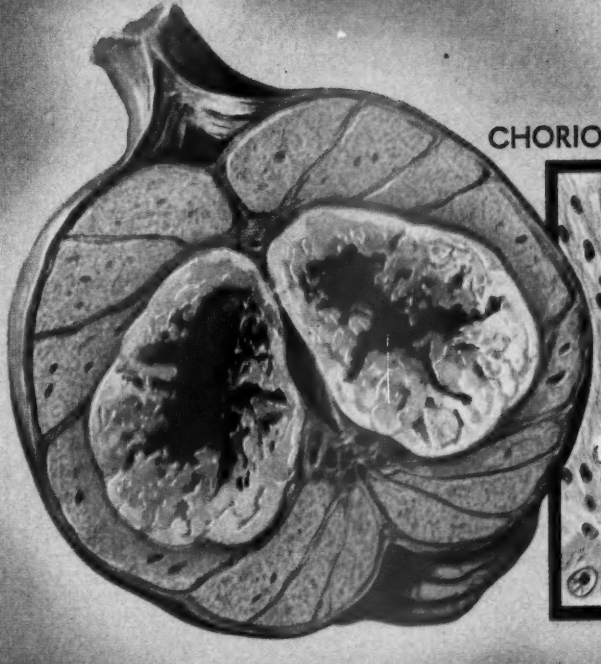


MALIGNANT TUMORS OF THE TESTICLE

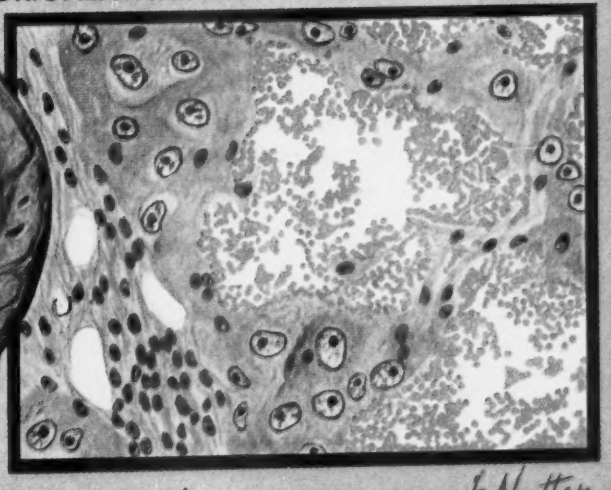
EMBRYONAL CARCINOMA
WITH LYMPHOID STROMA



EMBRYONAL
ADENOCARCINOMA
(Microscopic section
in circle)



CHORIONEPITHELIOMA



F. Netter M.D.

MALIGNANT TUMORS OF THE TESTICLE

(Continued)

Embryonal adenocarcinoma occurs far more frequently than adult teratoma. The gross appearance may be somewhat homogeneous due to considerable overgrowth of the epithelial elements, but more often it is nodular and cystic with areas of degeneration. Histologically there is a predominance of malignant embryonic epithelium. Islands of other tissue with varying degrees of differentiation may be found.

Embryonal carcinoma with lymphoid stroma is another type of teratoma in which there is an abundance of lymphoid tissue present along with the embryonal carcinoma cells.

Chorionepithelioma is a very interesting and highly malignant teratoma. It more often occurs as a small mass within a normal testicle but it may be part of a sizable tumor containing other types of tissue. Hemorrhage into the tumor is characteristic. The histologic elements are syncytial and Langhans' cells which surround blood spaces. This structure is similar to that seen in the chorionic villi of the fetal membranes and in chorionepithelioma in the female. Metastases are usually hematogenous, rapid and widespread. Enlargement of the breasts sometimes occurs.

* * *

Any firm, painless mass involving the testicle, whether smooth or lobulated, should be considered malignant until proven otherwise. The presence of gonadotropic hormone in the urine in many cases is of considerable diagnostic and prognostic value. This hormone in the urine is believed to indicate that the tumor has cells of primitive nature and is likely to be susceptible to radiation therapy. The persistence, or reappearance of gonadotropic hormone in the urine after orchidectomy, signifies the presence of metastases. An early diagnosis followed by orchidectomy and irradiation offers the best chance for cure.

Case Reports

DIAPHYSEAL TUBERCULOSIS

REPORT OF A CASE WITH RAPID DESTRUCTION AND SPONTANEOUS PATHOLOGIC FRACTURE

BERNARD N. E. COHN, M.D.
DENVER, COLORADO

TUBERCULOSIS of the shaft of a long bone is usually a slow, progressively destructive disease similar to that found in the metaphysis. Instances have been reported in which the disease has run a subacute[1,2] or even an acute course.[3,4] The following case is of interest because massive destructive of the ulnar shaft, complicated by a spontaneous pathologic fracture, occurred within four weeks after the onset of the first clinical symptoms.

CASE REPORT*

The patient was a white male, age thirty-four, of Greek nationality. The skeletal system was first involved in 1922 at which time he experienced pain and swelling of the right wrist. Although the diagnosis was apparently not clear at this time, according to the patient, an operation was performed following which sinuses developed and drained until 1924. In 1923, the right knee joint became swollen and was later complicated by draining sinuses. The knee was immobilized by plaster for twenty months, the drainage ceasing after two years. Tuberculous involvement of the cervicothoracic spine was first diagnosed in 1924. A posterior mediastinal abscess developed and drained through several sinuses on both sides of the neck. He was hospitalized in 1925 on account of the vertebral tuberculosis. At the time of discharge several months later, the sinuses on the left side of the neck had healed but slight drainage persisted from the right.

From 1925 until admission to the hospital in 1931 the drainage from the sinuses on the right side of the neck continued to increase slowly, being especially pronounced since 1930. He was also suffering from pain which radiated down the right arm. Limitation of extension and pain of the right elbow joint occurred in 1930.

Entrance examination in 1931 revealed a marked kyphosis involving the lower cervical and upper thoracic vertebrae associated with a draining sinus at the right base of the neck. The mediastinal abscess had increased somewhat in size. The right elbow joint was essentially negative for any pathological condition, except for slight limitation of extension. A roentgenogram of the elbow, taken at this time, did not reveal any osseous changes. The right wrist joint was somewhat puffy, with very little restriction of motion. The scars of the previous operations were noted. The circumference of the right knee joint was slightly greater than the left. The fingers showed a moderate degree of clubbing.

A notation in the entrance record stated that "numerous subcrepitant and crepitant rales over the lower two-thirds of the chest, especially posteriorly, were present." The patient did not cough or raise. It was thought that "these rales may indicate either a parenchymal tuberculous lesion or a slight degree of atelectasis due to prolonged bed rest."

Hospitalization was uneventful until 1934, at which time he experienced pain in the left ankle joint. This symptom disappeared spontaneously within a short period. Several months later, the pain, accompanied by swelling, recurred. Roentgenograms did not reveal bone changes. The treatment consisted of applying an elastic bandage.

* The author wishes to express his appreciation to Dr. William C. Black, Professor of Pathology, University of Colorado School of Medicine, for making this case available for study.

In June, 1934, the patient complained of abdominal distress, nausea, jaundice and pain over the right upper quadrant. The liver was enlarged, extending three fingers' breadth below the costal margin. A diagnosis of acute catarrhal jaundice was made, and appropriate treatment was instituted. Following the attack, the liver continued to enlarge slowly until it reached the level of the umbilicus where it remained.

In October, 1934, a slight effusion developed in the left knee joint, disappearing spontaneously after a few weeks.

There were no further events of importance until June 24, 1935, when the patient began to complain of pain in the right forearm. No history of trauma was obtained. The pain was situated about the junction of the proximal and middle thirds, being accompanied by swelling and a slight increase in local temperature. A roentgenogram taken on June 27 did not reveal any osseous changes. (Fig. 1.) Although the extremity was immobilized in a plaster splint, the pain did not subside. Examination of the involved area on July 20 showed

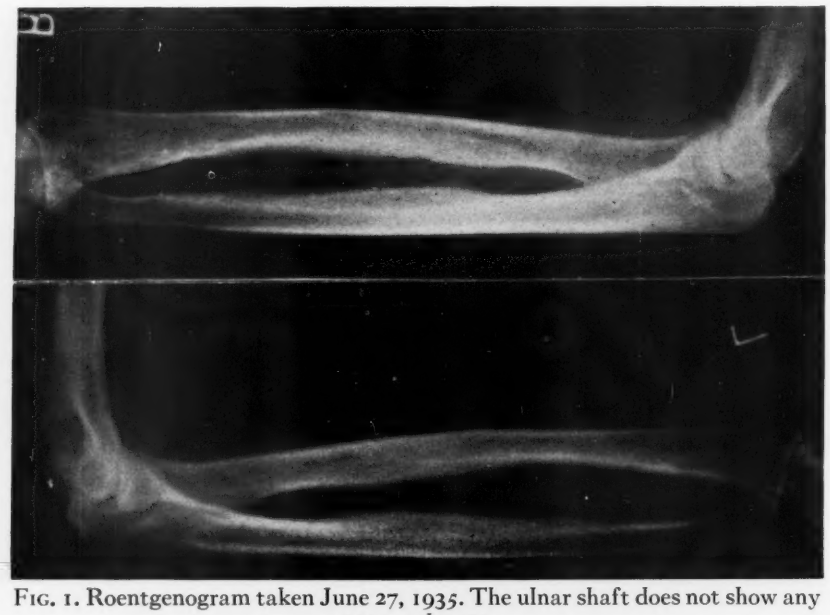


Fig. 1. Roentgenogram taken June 27, 1935. The ulnar shaft does not show any osseous changes.

Fig. 2. Check roentgenogram taken July 20. Marked destruction of the ulnar diaphysis is seen.

localized swelling associated with erythema and slight increased local heat. Fluctuation and marked tenderness on pressure were present. The white count was 15,000 cells with 85 per cent polymorphonuclears. A roentgenogram, taken on this date, showed a rarefied area in the proximal third of the ulnar diaphysis, about three inches from the joint, the cortex as well as the medullary canal being destroyed. There were no signs of metaphyseal involvement, and the elbow joint was clear. (Fig. 2.)

Because it appeared on July 20 that the abscess would rupture spontaneously, 10 cc. were first aspirated under aseptic precautions for study. A small incision was then made, from which about 50 cc. of thick, yellow pus were expressed. A posterior, moulded, plaster splint was applied to the entire extremity. A direct smear of the aspirated pus did not reveal tubercle bacilli or any other organisms. Culture of the pus for pyogenic organisms was negative. A guinea-pig which was inoculated with the pus died on September 19, tuberculosis being found at autopsy.

Several days following aspiration, abnormal mobility of the ulna was noted at the site of the abscess which had refilled. A diagnosis of pathologic fracture was made. Adequate incision and drainage were performed on July 30, at which time the pathologic fracture was verified. Soft tissue and several small fragments of bone were taken for histologic study. Vaseline packing was inserted and a cast applied. The microscopic examination of these specimens showed typical tuberculous caseation and granulation tissue.

A check roentgenogram, on August 19, revealed increased destruction of the ulnar shaft with no reparative signs. (Fig. 3.) An apparent attempt to bridge the defect in the shaft was noted in the roentgenogram taken on October 18. (Fig. 4.) There was no increase in the degree of destruction. The metaphysis and elbow joint were negative for any pathological condition in both films.

The postoperative course of the forearm was uneventful, although the wound continued to drain until death. In September, 1935, the patient began to compain of marked abdominal discomfort accompanied by ascites. The sedimentation rate increased to 99 mm. in one hour. A diagnosis of tuberculous peritonitis was made. On October 2, paracentesis abdominis yielded 1,000 cc. of serosanguinous fluid. Quantities as large as 5,100 cc. were aspirated on various occasions following the first tapping. Anasarca appeared on November 13. He

Fig. 3. Check roentgenogram taken August 19. There is almost complete local dissolution of the ulnar shaft.

gradually became weaker and died on November 27, 1935.

AUTOPSY FINDINGS

General. A complete autopsy was performed about sixteen hours after death. A brief summary of the more important findings will be given. The pulmonary tissue showed evidences of a long-standing tuberculous process with marked scarring of both apices. The paravertebral abscess caused compression of the right apex, being demarcated from the pulmonary tissue by a very thick, fibrous wall. The cardiac musculature was flabby. Upon opening the peritoneal cavity a large amount of serosanguinous fluid escaped. Generalized peritonitis was present, the peritoneum being studded with various sized tubercles. There were adhesions between many loops of bowel. The liver margin extended to the level of the umbilicus. The spleen was also enlarged. Amyloidosis of both organs was noted.

Skeletal. The proximal half of the right ulna and radius was removed. The kyphotic spine was also taken for study. The specimen of the

ulna consisted of the proximal 16.5 cm. (Fig. 5.) The shaft of the ulna was rounded approximately 7.5 cm. from the articulation. The apposing end of the distal fragment was likewise rounded. The two fragments were separated by a distance of 1.0 cm., the gap being filled with reddish-stained, soft tissue. The pieces at this point could be moved in any direction, denoting the pathologic fracture. A band of scar tissue traversed the volar aspect of the fracture. Osseous tissue was not palpable in this bridge. The rounded end of the proximal fragment was smooth; however, the apposing end of the distal fragment was eroded for a distance of 1.0 cm. The area of erosion was filled with greyish-white tissue.

Fig. 4. Check roentgenogram taken October 18. An apparent attempt has been made to bridge the defect.

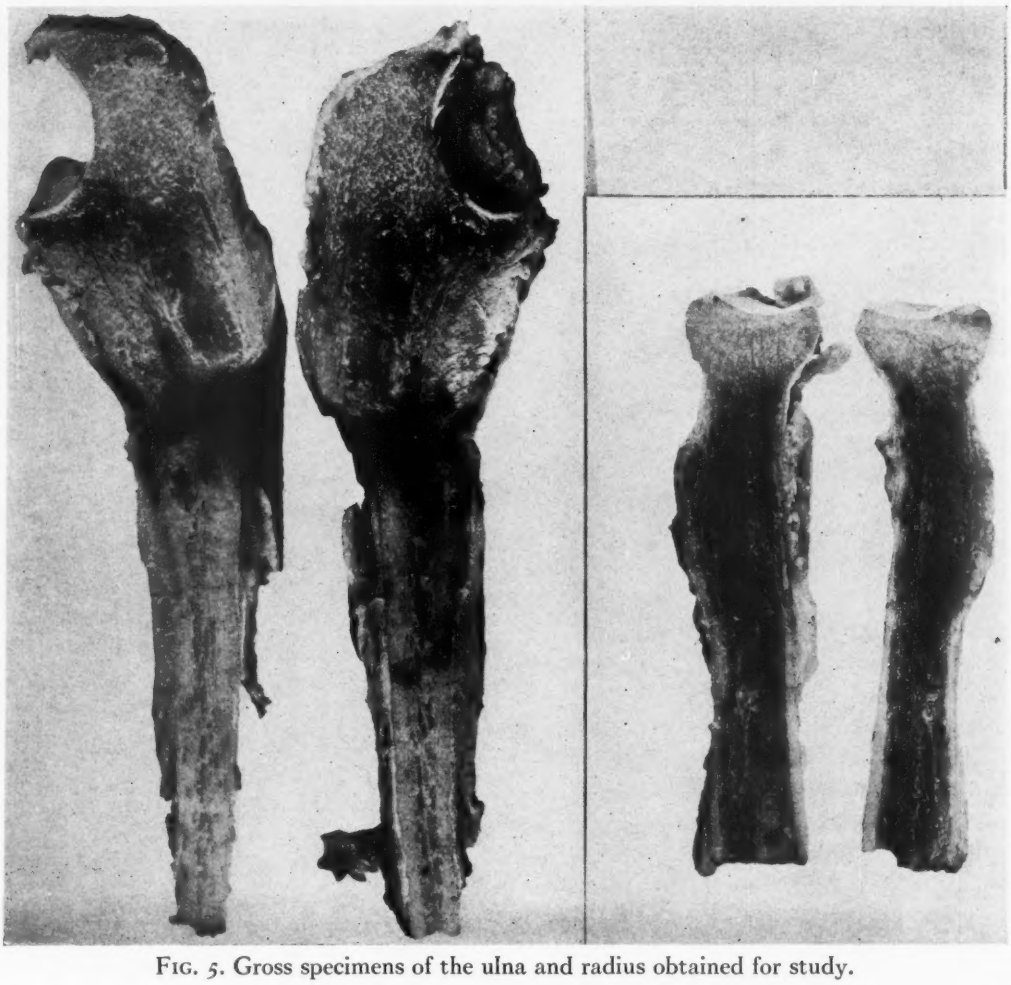


Fig. 5. Gross specimens of the ulna and radius obtained for study.

On section, the cancellous bone of the metaphysis and epiphysis of the proximal fragment appeared uninvolved grossly. The marrow tissue in these regions was fatty. The com-

ponents of the distal fragment were also negative grossly with the exception of the region directly adjacent to the pathologic fracture.

(Fig. 6.) In places, this tissue was densely infiltrated with pus cells.

The proximal end of the distal fragment was

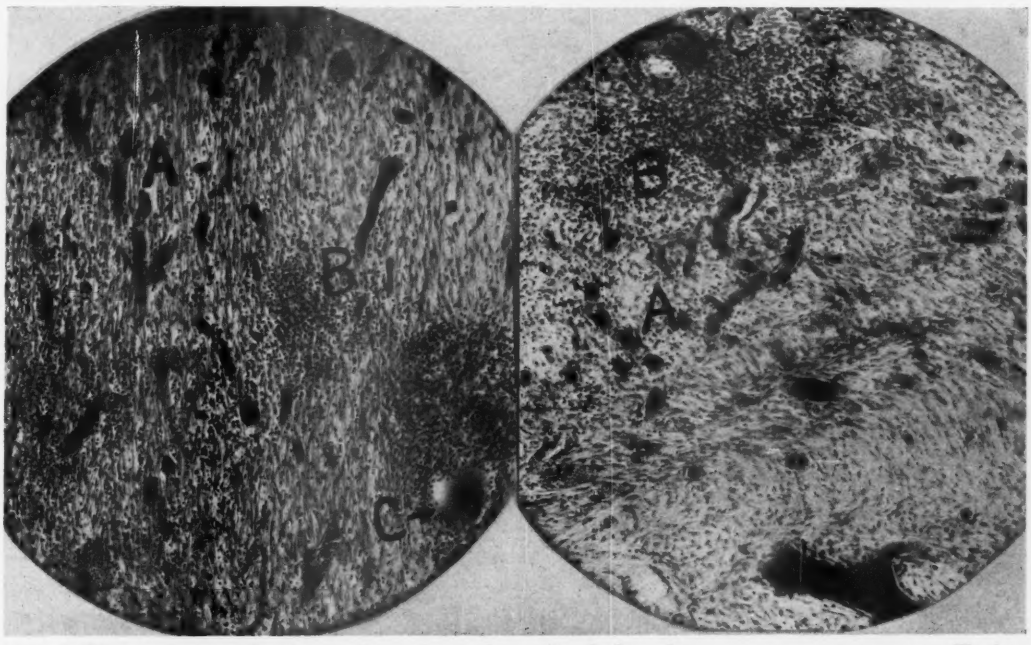


Fig. 6. Photomicrograph of scar tissue from the ends of ulnar fragments. A, numerous capillaries; B, lymphoid cells; C, Langhans' cell. × 150.

The articular cartilage of the semilunar notch was absent in the middle third, exposing the underlying bone. The remaining cartilage was thin and atrophic.

Gross examination of the radius did not reveal any significant changes, including even that portion of the bone which was directly opposite the involved area of the ulna. (Fig. 5.) On hemisection no pathologic findings, either in the osseous or marrow tissue, were noted.

Microscopic. Examination of the semilunar notch revealed that the articular cartilage was lacking in the central third and was very thin wherever present. It was atrophic in appearance with enlargement of many lacunae. There were no changes in the subchondral zone.

The metaphysis was entirely clear, the marrow being fatty with a sprinkling of hematopoetic elements. As the fracture site was approached, the fatty marrow was found replaced more and more by connective tissue. The first tuberculous area in the medullary canal was encountered 1.5 cm. from the site of fracture. In the immediate vicinity of the fracture, the marrow tissue was entirely fibrous. The end of the proximal fragment was covered by very vascular scar tissue. Numerous, large, Langhans' cells were encountered in this region. likewise covered with scar tissue in a manner similar to that of the described fragment. The tuberculous process extended 0.5 cm. into the medullary canal. The periosteum was infiltrated with tuberculous elements for 2.5 cm. along the shaft. The cortex contiguous to this area showed a slight increase in osteoclastic activity.

Osteoporosis of the cortex of both fragments was very pronounced. A few small areas of osseous proliferation were encountered at the ends of the fragments.

Study of the radius which was adjacent to the area of ulnar involvement did not reveal any tuberculous changes. Osteoporosis of the cortex was present, but not in the marked degree noted in the ulna.

COMMENT

The diaphysis of the ulna was attacked thirteen years after the first skeletal area was involved. During this time, several regions had definitely been attacked by tuberculosis, namely, the right wrist, right knee and cervicothoracic spine. There had also been transient symptoms of the left knee and ankle, which might possibly have been upon a specific basis. Reichel[5] believed that tuberculous osteomyelitis usually oc-

curred in individuals with multiple bone involvement, although this is not always the case.[6] It is noted that this patient had several bones infected prior to the development of the diaphyseal localization.

Evidence that this case was definitely one of primary diaphyseal localization and not an extension from a metaphyseal focus was proven histologically. The metaphysis was devoid of tuberculous areas. The focus in the ulnar diaphysis was probably due to the plugging of a vessel by a large embolus containing tubercle bacilli, according to the idea originated by Koenig.[7] Shutting off the principal blood supply to the region must have played an important rôle in the rapidity of the destruction. Simple proliferation of organisms which had adhered to the vascular endothelium with subsequent obliterative endarteritis tuberculosa, according to the theory of Orth,[8] could hardly account for such rapid dissolution of cortical tissue.

The previous repeated insults to the skeletal system should also be considered an etiologic factor. They may possibly have so worn down the resistance of the host that he was unable to withstand the effects of a large infected embolus.

From the histologic findings, it appears that the destructive process blew out through an abscess, rather than by extension along the medullary canal which was involved for only a short distance in either fragment. This picture does not coincide with the classical description of the infiltrative type of diaphyseal lesion, in which the tuberculous process extends for considerable distances along the medullary canal. It was noted histologically that the tuberculous elements could be traced for a maximum distance of only 1.5 cm. in the medulla, which is considerably less than may reasonably be expected. This case is apparently a combination of the so-called localized and infiltrative types, the infiltrative process being intensely more destructive than that usually encountered.

There was no clinical evidence at any time of sequestrum formation, the destruction of the cortical tissue apparently being complete. The absence of the articular cartilage of the semilunar notch was due to atrophy of disuse rather than tuberculosis of the ulnar metaphysis or epiphysis, which would have left some histologic trace of irreparable tissue damage.

Involvement of the ulna in this case corroborates the frequency with which this bone has been reported to be a site of predilection for diaphyseal tuberculosis by some authors.[2,9] Carrell and Childress,[6] on the other hand, found the tibia and femur to be the most frequently involved bones. Trauma, which may be a factor in the localization of the disease in certain cases, was not present in this instance.

SUMMARY

1. A case of tuberculosis of the ulnar shaft is reported, wherein massive destruction of the cortex took place. A spontaneous pathologic fracture occurred within four weeks from the onset of the first clinical symptoms.

2. This case represents a localized, infiltrative and rapidly destructive type of diaphyseal tuberculosis hitherto not reported.

3. The pathogenesis of such a lesion is discussed.

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ABDOMINOPERINEAL RESECTION WITH UNUSUAL COMPLICATIONS*

GARNET W. AULT, M.D.
Professor of Proctology, Georgetown University School of Medicine
WASHINGTON, D. C.

INTRODUCTION

THOSE of us who have had experience with the one-stage abdominoperineal resection of Miles for carcinoma of the rectum have come to expect complications of various types. Bladder dysfunction which may be followed by urinary infection is probably the most common complication. Cardiovascular accidents, pulmonary embolism, pneumonia and the usual long list of postoperative complications seen in all types of abdominal surgery are encountered. It is beyond the scope of this article to discuss their diagnoses and management.

CASE REPORT

Mr. J. F. C., white, male, age forty-six, a government clerk by occupation, was referred to me on February 17, 1940. He had been treated by a chiropractor for bleeding hemorrhoids in 1937 and 1938. Stool examinations, made in two different laboratories in the fall of 1938, were positive for blood. No parasites were found. A gastrointestinal series and barium enema, with air contrast, were reported as normal by a competent radiologist in the fall of 1938. The patient was lost sight of until January, 1940, when he consulted Dr. L. H. Snyder stating that he had been treated (unsuccessfully) elsewhere for ulcerative colitis. Dr. L. H. Snyder referred him to this office on February 17, 1940, at which time a proliferative and ulcerative carcinoma of the upper rectum was seen upon proctoscopic examination. The lesion was located at 5 inches, it was quite large, freely movable and was complicated by hemorrhoids. Biopsy revealed it to be an adenocarcinoma-cylindrical cell type, Grade 3 (Dr. O. B. Hunter). A preoperative period of ten days' preparation was used and on February 27, 1940, a one-stage abdominoperineal resection (Miles) was done without any technical difficulty at Emergency Hospital. At operation the regional lymph-nodes were involved and a nodule about 1 cm. in diameter could be felt on the undersurface of the left lobe of the liver. The permanent colostomy emerged from the midline incision midway between the umbilicus and pubes. The left colic gutter was not closed as has been suggested by Rankin[2] as we do not make a left McBurney stab-wound type of colostomy. Microscopic sections of the specimen by Dr. L. Newman showed an actively proliferating adenocarcinoma Grade 3 which infiltrates the muscle and the regional lymph-nodes (Dukes Classification Type C). The patient had a satisfactory postoperative course, being allowed out of bed on the twentieth postoperative day.

About noon on the twenty-first postoperative day, March 19, 1940, the patient felt a sudden, severe, cramping pain in the left lower quadrant. The pain was griping in character and occurred while he was standing on the footstool in the act of climbing into bed. Examination one hour later revealed a splinting of the left side of the abdomen with rebound spasm. Upon inserting the finger into the colostomy, the space between the colostomy and the left anterior iliac spine felt rather full and was exquisitely tender. *One could not approximate the finger inserted into the colostomy and the hand on the skin of the left lower quadrant.* (Fig. 1.) Decompression was attempted with the Miller-Abbott tube during the late afternoon and overnight. An *x*-ray in the morning revealed the tube to be coiled up in the stomach The large and small intestine showed dilated loops typical of obstruction. The patient was sent to the operating room with a diagnosis of small bowel obstruction due to a herniation down the left colic gutter. Under spinal anesthesia the abdomen was entered through a right rectus incision. A loop of small intestine (probably jejunum) had rotated and strangu-

* From the Department of Proctology, Georgetown University School of Medicine, Washington, D. C.

FIG. 1. Showing the method of examination for herniation and strangulation around the colostomy.

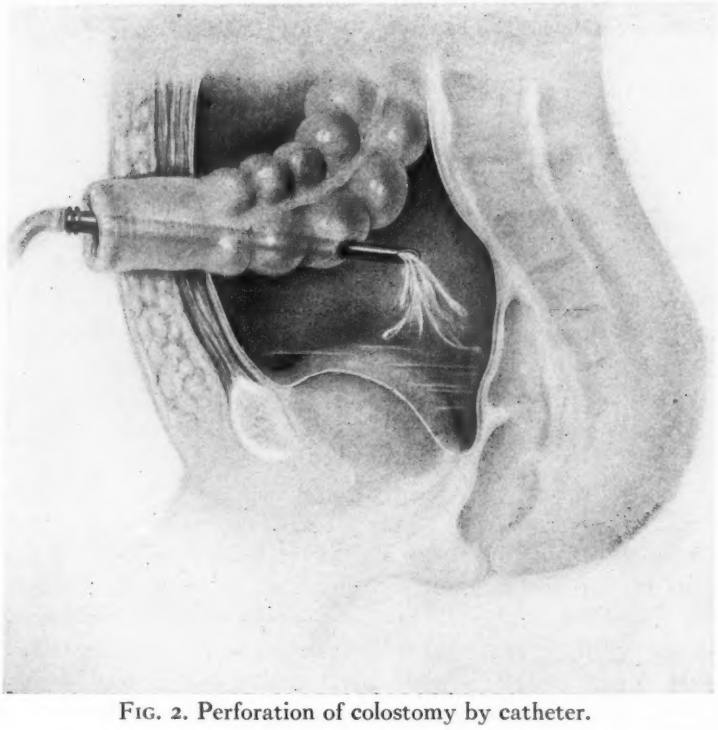

FIG. 2. Perforation of colostomy by catheter.

lated itself around the colostomy by descending in the left colic gutter. The gangrenous gut was delivered with difficulty and without rupture. Sixteen inches of bowel were resected and an end-to-end anastomosis performed. Enterostomy was not done. The abdomen was closed without drainage. The patient made a satisfactory recovery until the fourth postoperative day when he developed a phlebitis of the left leg. The edema and swelling did not extend much above the calf and he was allowed out of bed on the nineteenth postoperative day and discharged home, April 15, 1940, the twenty-fifth postoperative day, it then being forty-seven days since his abdominoperineal resection.

The patient had been instructed to take a daily enema before breakfast in the following manner: He was to insert slowly a No. 28 F. catheter into the colostomy for about 3 inches. A wash cloth, wrapped around the catheter, was to act as a stopper and prevent leakage until about 1,000 cc. of plain water was used. The return flow was to be expelled into the enema can or the toilet bowl. He was not confined to the house and was gaining weight and strength in anticipation of his return to work about May 15, 1940.

About 8:00 A.M., May 8, 1940, he inserted the tube with slight difficulty and "the lukewarm plain tap water ran in easier than ever before." There was no pain or cramps and no return from the enema. He felt well for about one and one-half hours and about 9:30 A.M. he was seized with violent peristaltic cramps. The abdomen became hard and rigid. He had a chill and when I was called to see him about 1:00 P.M. he was in a state of shock with a board-like abdomen. A diagnosis of perforation of the colon was made (Fig. 2) and he was again admitted to the hospital. Roentgen examination of the abdomen in the prone and upright position revealed some dilatation of the stomach but no free air under the diaphragm. About 5:30 P.M., under spinal anesthesia, the old right rectus incisional scar was removed and the abdomen opened. Both clear and cloudy fluid containing a few flakes of feces escaped. A considerable amount of fluid was removed by suction. The culture of this fluid subsequently showed Bacillus coli and Bacillus aerogenes. The site of perforation could not be found as the patient's condition did not warrant prolonged search for it. Repair of the perforation was therefore not done. A penrose drain was inserted toward the pelvis and the incision closed by through-and-through sutures of alloy steel wire. The patient had a stormy postoperative course. Frank purulent drainage did not appear until about the tenth postoperative day, the drain being removed the twelfth postoperative day. From the fifteenth postoperative day the patient began to improve. He was finally discharged the twentieth postoperative day and the wound closed spontaneously without retention of pus about nine weeks later. He returned to his previous occupation about September 1, 1940, weighing 128 pounds (six pounds more than when I first saw him). When last seen June 18, 1941, his nutrition was good and his blood count was within normal limits.

COMMENT

This case needs very little comment, except to pay tribute to a heroic individual who has survived his surgeon's efforts to date. His reward should be greater than I anticipate for him in the future, as he had a Grade 3 (Broders) type C (Dukes) adenocarcinoma of the rectum with infiltration of the regional lymph-nodes and a nodule in the liver. He has been restored to his previous occupation which is some justification for his additional operations. It is obvious that these additional operations were carried out with scant enthusiasm on my part as they were well tinctured with a pessimistic outlook for the patient.

It is of interest that this strangulation occurred around a colostomy placed in the midline. This colostomy location leaves a rather large space down the left colic gutter. A colostomy made in the left lower quadrant actually creates a small opening for an internal hernia if the peritoneum is not closed with a purse string suture. In this case the peritoneal space between the midline colostomy and the left colic gutter was left open as we believed it was too large an area to permit strangulation.

Finally, it is to be noted that perforation of the rectum or bowel by enema tips and allowing the enema to enter the peritoneal cavity probably carries a mortality rate greater than 40 per cent.[1]

CONCLUSIONS

1. A case of abdominoperineal resection (Miles) of the rectum is reported.

2. Volvulus, strangulation and herniation of a loop of small intestine down the left colic gutter and around the colostomy is reported as a complication.

3. Perforation of the colon (colostomy) by a soft rubber catheter and the administration of an intraperitoneal enema is also reported as a complication.

4. *Inability to approximate the finger inserted into the colostomy and the hand placed on the skin of the left lower quadrant* is reported as a finding in herniation of the small intestine down the left colic gutter. Obliteration of this palpable space accompanied by exquisite tenderness and a board-like abdomen favors the diagnosis of strangulation.*

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* An additional case of volvulus has been encountered since this report.

Bennett emphasizes that when paralysis occurs during poliomyelitis, an estimate of the injury to the anterior horn cells of the spinal cord cannot be made, but muscles presenting varying degrees of weakness must be considered. The degrees of recovery depend upon the extent of damage to the cells of the spinal cord.

GASTROJEJUNOCOLIC FISTULA*

REPORT OF A CASE

MAX BORNSTEIN, M.D., F.A.C.S. AND LEO R. WEINSHEL, M.D.
Head of Department of Surgery, Mt. Sinai Hospital Adjunct Surgeon, Mt. Sinai Hospital
MILWAUKEE, WISCONSIN

GASTROJEJUNOCOLIC fistula is a comparatively rare complication following gastrointestinal surgery. We[1] made a collective review of the literature, and found that only 322 cases of gastrojejunocolic fistula have been reported since 1893. It may be that many other cases existed but were overlooked or not recognized.

In our study of the literature we found that the average case of gastrojejunocolic fistula occurred within four and one-half to nine years following gastroenterostomy, while a few cases have been reported as early as six weeks following surgery, and some eighteen years later. The case that we are reporting, is of particular interest because a gastrojejunocolic fistula developed twenty-one years after a gastroenterostomy for duodenal ulcer, and we know of no other instance in which this complication occurred at such a late date.

CASE REPORT

A. S., a white male, blacksmith, age thirty-two, married with one living child, was first admitted to Mt. Sinai Hospital on July 16, 1919. He gave a history of epigastric pain and distress for two years. The pain in the stomach became most severe after eating and was aggravated by all kinds of food. Soda did not relieve the pain. For three weeks preceding his admission to the hospital the pain had become progressively worse and the patient had several attacks of vomiting. He noticed that the vomitus was of a coffee-ground color. He also lost twelve pounds in those three weeks.

Upon physical examination the patient was found to be fairly well developed and well nourished. The pulse, temperature and respirations were normal. The blood pressure was 126/70. In the epigastrium there was spasm of the recti muscles and tenderness and rigidity over the pyloric region of the stomach. At the end of fifteen minutes, following the administration of a barium meal, no duodenal cap was visualized, the stomach was of immense size and there was a large dilated pylorus. At the end of six hours, no duodenal cap was present; nothing was seen passing through the pylorus and the fundus was contracted and the pylorus dilated. At the end of twenty-four hours, there was considerable gastric retention, the pylorus was still full, there was some barium in the cecum and the pyloric mass was movable.

The preoperative diagnosis was pyloric obstruction due to a scarred ulcer or malignancy.

The operation was performed by the senior author (M. B.) on July 18, 1919. The stomach was found to be dilated. A mass the size of a fist was felt in the posterior portion of the pylorus. This mass was adherent to the gallbladder and duodenum (at the site of an old adherent ulcer) and to the head of the pancreas. A partial gastrectomy was performed followed by a posterior gastroenterostomy. Postoperative diagnosis was pyloric obstruction caused by peptic ulcer with much scar formation.

Twelve days later the patient was discharged from the hospital in excellent condition. During the years that followed the patient gained weight and resumed his work without symptoms.

On January 16, 1940, the same patient, now aged fifty-three, with six living children, a painter for the past twelve years, was admitted to Mt. Sinai Hospital for the second time. At this time he gave a history of abdominal pain, onset three years ago, which had gradually become worse. The pain was sharp and burning in character and spread over the lower abdomen, whereas, the pain twenty-one years ago was present just below the xiphoid. The present pain usually came on one and one-half to two hours after eating, was accompanied by dis-

* From the Department of Surgery, Mt. Sinai Hospital, Milwaukee, Wisconsin.

tention, bloating, "rumbling," and was relieved by defecation, alkalinization or milk. The pain was usually present when his stomach was empty. For the past eighteen months the patient had a persistent diarrhea, and frequent emeses of fecal material. About two years ago the patient noticed bright red blood in the stool following an attack of diarrhea but lately no blood had been noticed. His appetite was good; there was no qualitative food intolerance except for apples. For the past year he has persistently felt weak and tired and lost thirty-five pounds in weight.

Upon physical examination the patient was found to be rather emaciated, very weak, and a generalized pallor was present. He weighed one hundred thirty pounds. The temperature, pulse and respirations were normal. The blood pressure was 120/74 and the heart and lungs were essentially negative. The abdomen was protuberant. There was an old healed scar in the right upper quadrant, with a defect and expansile mass (a ventral incisional hernia). No tenderness, masses, or rigidity were noted. He had bilateral varicose veins, otherwise, the extremities were negative. The leucocyte count of the blood was 7,450 per cubic millimeter; the hemoglobin measured 69 per cent; the erythrocyte count was 3,310,000 per cubic millimeter; poikilocytosis, anisocytosis and hypochromia were present. The blood sugar was 117.6 mg. per 100 cc. and the blood nonprotein nitrogen was 22.5 mg. per 100 cc. The urine was essentially negative.

The preoperative diagnosis was gastrojejunal ulcer with possible fistula.

On January 18, 1940, following adequate preoperative therapy, the patient was taken to the operating room and under nitrous oxide induction followed by ether anesthesia, a left rectus incision was made. Upon exploring the abdomen a gastrojejunocolic fistula was found. The involved transverse colon was excised widely, and all indurated colon which might be malignant was removed and an end-to-end colonic anastomosis was done. The previous posterior gastroenterostomy was taken down. The jejunum was excised at the site of the ulcer and a new gastric opening was made and this was anastomosed to a loop of jejunum distal to the repair of the previous jejunal opening thus creating a new gastroenterostomy. The abdomen was closed in layers and without drainage. The operation was quite difficult owing to multiple adhesions.

Fourteen days later the patient was discharged in excellent condition. He was seen on April 20, 1940, and at that time he had regained twenty-five pounds, was feeling stronger and had no complaints or symptoms. He had resumed his work. He was last seen on September 14, 1940, and at that time he weighed one hundred seventy pounds. His appetite was good, and he had no gastrointestinal symptoms whatsoever.

CONCLUSION

A case is reported of a gastrojejunocolic fistula which developed twenty-one years after a primary operation (partial gastrectomy and posterior gastroenterostomy) for duodenal ulcer. Recovery followed when a secondary operation was performed, at which time the gastrojejunocolic fistula was resected, colonic end-to-end anastomosis done, and a new gastroenterostomy created, after the previous posterior gastroenterostomy was taken down. The treatment of this condition is surgical intervention, for the fistula is of a progressive nature, and death will result if the fistula is not recognized and treated properly.

This report seems to be justified, for, in our review of the literature, we found no other case of gastrojejunocolic fistula which developed at such a late date.

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CARCINOMA OF THE COLON IN A CHILD OF FOURTEEN YEARS*

WITH A REVIEW OF THE LITERATURE

T. KERR LAIRD, M.D.
Resident in Surgery, Laird Memorial Hospital
MONTGOMERY, WEST VIRGINIA

IN reviewing the recent literature one is impressed with the frequency of reports dealing with neoplastic lesions in infancy and early childhood. No detailed survey is available regarding the distribution of cancer in children, but apparently the kidney and ovary are more frequently involved than any other organs. The percentage of lesions occurring in the colon, however, corresponds rather closely to that in adults. Fowler[4] (1926), in reviewing a large number of malignancies in patients under twenty-six years of age, found that 18.7 per cent involved the large bowel, and of these 12.5 per cent occurred in the rectum and sigmoid. Louart[5] (1900) was the first to review the literature, collecting seventy-six cases of cancer of the large intestine, excluding the rectum, but he included patients up to the age of thirty. Bauer and Bertim[2] (1914) added twenty-one additional cases. Phifer[14] (1923) reported forty-nine cases of proven cancer of the sigmoid and rectum under the age of twenty-one years. Twenty-two of these patients were under the age of fifteen. Bacon and Sealy[11] (1939) found one hundred twenty-three authentic cases of malignancy of the sigmoid, rectum, and anus under the age of twenty, and of these, fifty-one occurred under the age of fifteen. Other than one case which occurred in a newborn monster, the youngest patient in this series was three years of age.

This report deals with malignancy of the colon, proximal to the sigmoid, and is limited to patients under the age of fifteen. The first case was reported by Spanton and Frost[19] (1878), and occurred in a female twelve years of age. Since that time there have been seventeen additional cases reported. These are summarized in Table 1.

Of the eighteen cases, nine occurred in males and nine in females. The cecum was involved in 50 per cent of the cases; of the remaining nine, the lesion was located in the ascending colon in two cases, in the transverse colon in two cases and in the splenic flexure in five cases. In fourteen cases the symptoms were reported, and in all, the presenting symptom was abdominal pain. In addition, nine patients complained of vomiting, six of constipation, and in only two cases was there a history of bloody stools. As pointed out by Bacon and Sealy, this is in contrast to the symptomatology in adults in which bleeding is the most common symptom.

All of the fourteen patients were operated upon; all died except two. Mayo-Robinson[7] reported that his patient was alive six months after operation and Warthen's[22] patient was living three months after operation. In eight of these fourteen cases, the preoperative impression was either tuberculous peritonitis or obstruction due to tuberculosis.

CASE REPORT

A fourteen year old, American male was admitted to the Surgical Service of the Laird Memorial Hospital on October 23, 1938, complaining of generalized abdominal pain, general malaise and progressive weight loss. The patient's past health had been excellent and there was no history of carcinoma or tuberculosis in the family.

* From the Surgical Service, Laird Memorial Hospital, Montgomery, West Virginia.

The present illness began in August, 1938, when he first noticed the gradual onset of vague, cramp-like, abdominal pain, which began in the left upper quadrant and radiated over the course of the colon. This was accompanied by general malaise, anorexia and a low-grade fever. The pain increased in severity, and ten days prior to admission some abdominal distention was first noted. This had gradually progressed to the point that he was quite dyspneic. His weight had dropped from one hundred fifteen pounds to eighty-five pounds. The bowels had continued to move normally and no blood was noted in the stools.

TABLE I

	Sex	Age	Location	Symptoms	Microscopic Diagnosis
Walker and Daly[20]	M	5	Cecum	Abdominal pain, vomiting	Adenocarcinoma
Pfeiffer and Wood[2]	M	7	Transverse colon	Abdominal pain, constipation	Fibroma with adenocarcinoma
Phaln[13]	F	9	Cecum		
Mouchet and Baranger[8]	F	10	Splenic flexure	Abdominal pain, vomiting	Adeno-epithelioma
Wainwright[22]	F	11	Splenic flexure	Abdominal pain, diarrhea	Gelatinous carcinoma
Rocher and Guerin[17]	M	11	Splenic flexure	Abdominal pain, vomiting	Epithelioma
Spanton and Frost[19]	F	12	Cecum	Abdominal pain	Encephaloid
Maydl[6]	F	12	Cecum		
Nothnagel[10]	M	12	Cecum		
Maydl[6]	M	13	Cecum		
Ruczynski[18]	M	13	Splenic flexure	Abdominal pain, bloody stools	Adenocarcinoma
Muralt[9]	M	13	Ascending colon	Abdominal pain, vomiting	Colloid carcinoma
Ogilvie[11]	M	13	Splenic flexure	Abdominal pain, vomiting	Spheroidal-cell carcinoma
Rawls[16]	F	13	Splenic flexure	Abdominal pain, constipation	Signet-ring adenocarcinoma
Mayo-Robinson[7]	F	14	Ascending colon	Abdominal pain, constipation	Columnar epithelioma
Chajintin[3]	F	14	Cecum	Abdominal pain, bloody stools	Adenocarcinoma
Pouzet[15]	F	14	Cecum	Abdominal pain, vomiting	Epithelioma
Warthen[22]	F	14	Transverse colon	Abdominal pain, constipation	Signet-ring adenocarcinoma

Physical examination on admission revealed an emaciated, dehydrated, acutely ill patient.

His temperature was 99.8°F. The head and neck presented no abnormalities. The heart and lungs were normal but the diaphragm was elevated. The abdomen was symmetrically distended with fullness in the flanks and shifting dullness. There was slight tenderness over the entire abdomen but there were no palpable masses or viscerae.

Routine laboratory studies revealed an erythrocyte count of 4,700,000; hemoglobin 90 per cent; leucocyte count of 17,000, with 70 per cent polymorphonuclear leucocytes. The Kahn test and urinalysis were negative. There was no

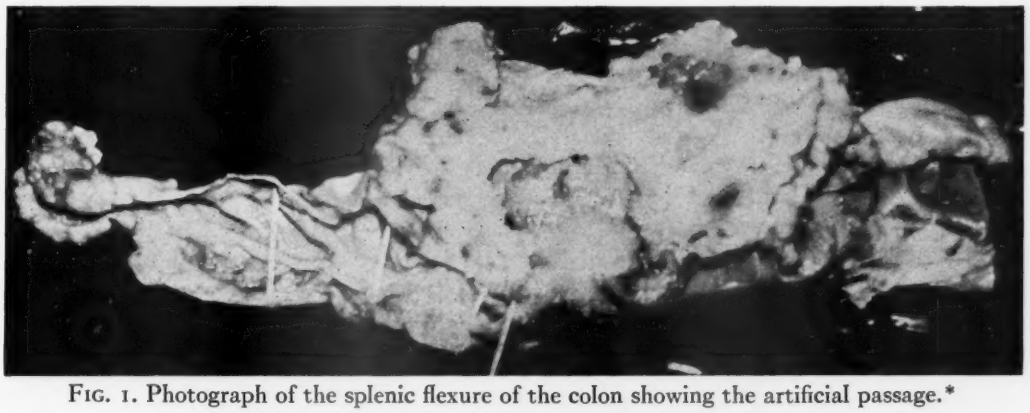

Fig. 1. Photograph of the splenic flexure of the colon showing the artificial passage.*

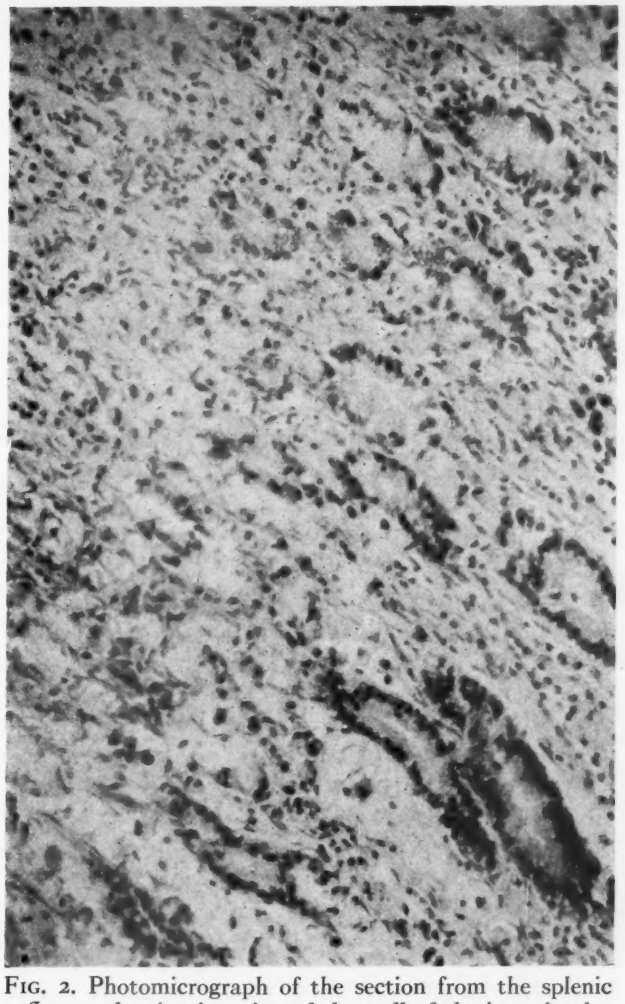

Fig. 2. Photomicrograph of the section from the splenic flexure showing invasion of the wall of the intestine by tumor cells.*

* Photographs by Army Medical Museum.

occult blood in the stools. Fluoroscopic and roentgenologic examination of the chest and spine were negative.

With a tentative diagnosis of tuberculous peritonitis the abdomen was explored through a midline incision under ether anesthesia. Approximately three liters of clear, amber fluid were removed. The omentum consisted of a mass of irregular, white, translucent, discrete nodules, varying in size from ½ to 3 cm. The entire parietal peritoneum and mesentery were covered with similar nodules, and the splenic flexure of the colon and spleen were bound together in a large mass. There were no dilated loops of intestines noted. The liver and stomach were free of invasion. An omental biopsy was obtained and the abdomen closed.

The wound healed but the postoperative course was steadily retrograde. The abdomen gradually became distended and the patient died thirty days following operation. This was three months after the onset of the symptoms.

Pathological Report. The examination was limited to the abdomen. The stomach, duodenum, liver and kidneys were grossly normal. There were many large, pedunculated tumor nodules hanging from the colon and spleen. These organs, with the tail of the pancreas, were bound together in a large mass which was removed in toto. After fixation, the mass was opened from below upward; and at the splenic flexure there was marked thickening of the walls with almost complete obstruction of the lumen. Through this mass, which was yellow-white, soft, and resembled a colloid carcinoma, there was a false passage measuring approximately 3 by 3 by 3 cm. (Fig. 1.) Fragmentary portions of muscle wall could be seen in the mass. There was no gross evidence of leakage.

Microscopic. For sake of simplicity the operative biopsy is being included in the necropsy report. The sections of omentum removed at operation showed various sized nodules composed of a delicate network of fibrous tissue supporting tumor cells. The cells were anaplastic, pleomorphic and hyperchromic. The cytoplasm was light and faintly granular, and the nuclei were, for the most part, eccentrically placed. Numerous, atypical, mitotic figures were seen. Between the cells there was a matrix taking the hematoxylin stain which appeared to be of colloid nature. In numerous areas the cells assumed an atypical, glandular structure. In the sections taken from the tumor of the colon the cells had the same general characteristics. However, the gland formation was more definite and on the inner border there were degenerative changes with infection superimposed. (Fig. 2.) The false passage described grossly was lined with a thick necrotic membrane resting upon degenerative tumor cells. Microscopic studies of the remaining viscerae revealed no histological evidence of metastatic tumor.

Diagnosis: Colloid adenoma of the splenic flexure of the colon.

CONCLUSIONS

Eighteen authentic cases of carcinoma of the colon are reported occurring in children under the age of fifteen years and proximal to the rectosigmoid junction.

A case report is presented of colloid carcinoma of the splenic flexure of the colon in a white male of fourteen years.

In the fifteen cases in which the histories were reported, all patients complained of abdominal pain as the presenting symptom, and in only two cases was there a history of bloody stools. This is in direct contrast to the symptomatology in adults in whom rectal bleeding is the most frequent presenting symptom.

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The chief life-saving measures are the mechanical respirator, postural drainage, and convalescent serum. The chief agents for the prevention of deformity are proper bed posture and splinting.

RECURRING JEJUNAL INTUSSUSCEPTION*

E. P. Coleman, M.D., F.A.C.S., R. H. Maguire, M.D. and D. A. Bennett, M.D.
CANTON, ILLINOIS

INTUSSUSCEPTION is one of the less common of the many pathologic conditions producing intestinal obstruction. It may be classified in a variety of ways descriptive of the part involved, such as ileocecal intussusception, which is the commonest type, the ileocolic, the colonic and the enteric. The enteric type may be subdivided into the ileal, the ileojejunal and the jejunal. An intussusception may be peristaltic or antiperistaltic, and both of these have been found in the same patient. Furthermore, retrograde intussusception has been found through a gastroenterostomy stoma.

From the standpoint of symptomatology, however, there are only two general classifications. The first or common form is the ileocecal variety, which occurs in children usually under the age of two years and which has a clinical symptom complex with which we are all familiar. Except in a few rare cases in which there is spontaneous reduction, this type of intussusception, unless reduced by inflation or enemas, constitutes an acute abdominal emergency which requires immediate laparotomy. Furthermore, when once reduced during laparotomy, it is unlikely to recur. The ileocecal variety has been thoroughly recorded and discussed in many articles, but the jejunal type has a different group of symptoms and it is not so well understood. Despite this, it has a symptomatology that is rather characteristic and which should call for a correct diagnosis in most instances. The fact that jejunal intussusception is not recognized early is due primarily to a lack of understanding of its characteristic symptoms so that most doctors fail to consider it in a patient with chronic upper abdominal symptoms.

Freilich and Coe, in an excellent article, have reviewed the literature on jejunal intussusception up to June, 1936. Their findings emphasize its comparative rarity. In 3,284 cases of intussusception reported, there were 462 or 14 per cent of enteric cases, and of these only twenty-nine or 0.9 per cent were of the jejunal type. Additional reports are limited to five other jejunal cases, and these had symptoms in common with those previously recorded.

Statistics indicate that about 5 per cent of all intussusceptions occur in adults, but this figure is practically reversed in the jejunal cases; for although one such case is reported at the age of four months, it appears to be mainly a disease of adult life. It is also a disease associated with some other abdominal pathology, for of the thirty-four cases recorded, twenty-nine had some type of neoplasm present. These lesions either malignant or benign were found within the lumen of the bowel and they were the presumptive factor in producing a telescoping of the bowel. Such underlying pathological manifestations may be present in intussusception of any part of the intestinal tract after the age of two years, but they are apt to be found especially in the jejunal type. Polyps were among the common tumors present in the cases reported. Nine jejunal cases presented double or triple intussusceptions; and while a few were retrograde, one case reported by Ryan and Morgan gave the unusual picture of a quadruple intussusception. Two of these were peristaltic and two retrograde or antiperistaltic, the four being delivered as one mass.

The five remaining jejunal cases had no tumor and no other demonstrable condition that might produce them, so they may be classified as primary or spontaneous. It is interesting to learn that in a few recurring

* Read before the Western Surgical Association at Topeka, Kansas, December 7, 1940.

cases of ileocecal intussusception in which no tumor was discovered within the lumen of the bowel, an abnormally long mesentery was noted, which in the absence of other findings appeared to be a causative factor. This may have been present in these otherwise primary jejunal cases.

An intussusception that has been produced experimentally, tends to reduce itself spontaneously, and this may occur in some of those which develop spontaneously. Undoubtedly, this is true of certain jejunal cases because they have had recurring symptoms, including the presence of a palpable tumor, and later obtained relief of symptoms with disappearance of the tumor. In several cases the same condition obtained many times before an irreducible tumor developed and was found at operation.

When the intussusception is not reduced, the telescoped bowel acts as a foreign body and increased peristalsis tends to force it farther and farther along the intestinal tract. The mesentery is drawn in and pressure upon it produces much of the pain and shock. Further pressure on the mesentery finally interferes with the blood supply and the telescoped portion becomes gangrenous.

Symptoms of jejunal intussusception may be present for months or years and are usually intermittent. There is always a history of upper abdominal pain. This may be exceedingly severe during some attacks, and occasionally it follows the ingestion of food. However, there are numerous attacks of much less severity. A vague pain in the epigastrium may be present most of the time between the severe attacks. Nausea and vomiting are common but only when they accompany the acute symptoms. Blood in the stools, found routinely in the infantile or ileocecal cases, is not of regular occurrence in jejunal intussusception and is recorded in only 25 per cent of those reported. Also a mass palpable during the acute paroxysms of pain is found in over half of these cases. *X*-ray findings have been reported very seldom and were of diagnostic aid only occasionally, but they should be under more favorable circumstances.

The following case report is one in which the diagnosis was not made correctly until after laparotomy, but a study of the history indicates that intussusception should have been considered long before an emergency operation became necessary.

Fig. 1. Stomach and colon both displaced by pressure of the central mass.

This case is of unusual interest because of the duration of symptoms and because of the large amount of tissue that had to be resected (205 cm.).

CASE REPORT

Mrs. E. L., aged thirty-eight, para 3, was seen at the Graham Hospital, Canton, Illinois, on the morning of July 6, 1939, having been taken there while suffering with an attack of severe abdominal pain. She gave the following history: At the age of thirty-three, five years ago, she developed abdominal pains, cramp-like in character, which usually occurred in the morning. These were not severe, lasted only a half hour and then disappeared for from one to two months. Soon, however, they increased both in frequency and severity and she had to vomit because of the associated nausea. At first this gave complete relief, and in subsequent attacks she resorted to voluntary vomiting, which usually caused the pain to leave completely. As the attacks became more frequent she could anticipate them. Eventually, she would be awakened about 2 A.M. with intense

pain, and she would vomit and take enemas with varying degrees of relief. As time passed, vomiting ceased to relieve the condition. For

Fig. 2. Drawing showing appearance and cross section of the tumor.

the past two years she had been uncomfortable most of the time and she had some pain almost every fifteen minutes all day long every day. These pains were not intense as in the occasional severe attacks, but the patient had an uncomfortable feeling and a sense of abdominal movement with slight pain most of the day. She also had become extremely nervous.

She was seen by Dr. R. H. Maguire on numerous occasions when she was suffering from the severe attacks and also in the intervals between them. During these intervals, the physical findings were entirely negative, but when an attack was present, he could feel a definite mass in the right side of the abdomen. Careful manipulation of this mass would cause it to become smaller and smaller, until it finally disappeared and then the patient's symptoms would be relieved at once. However, a definite tenderness would remain about two inches above McBurney's point after the attacks and soreness would persist for several hours. Visible peristalsis was usually present. Dr. Maguire's impression was that the patient had a partial obstruction due to adhesions from a previous appendicitis. Accordingly, he did an appendectomy in May, 1935, two years after the onset of symptoms. The appendix was normal, and a careful exploration of the pelvis and right side of the abdomen failed to reveal any pathological condition to account for the symptoms.

The patient's postoperative course was normal until the ninth day when the old symptoms recurred and a large mass could be palpated, but it again disappeared during the course of the abdominal examination. Several weeks later, another attack occurred, but this time the doctor was unable to feel the mass. On numerous occasions during the next four years he saw her with the same symptoms, but all physical findings were negative. She was very nervous and weighed only one hundred pounds. The heart and lungs were normal as well as the blood and urine. The patient never passed blood in the stools and had no diarrhea with or without the attacks. During the past year, she developed a moderate secondary anemia. Dr. Maguire had had her examined at three different clinics with complete physical, *x*-ray and laboratory check-ups. The findings were all to the same effect; namely, that she had a spastic colitis, and that her pains were of a spasmodic nature due to some nervous condition. None of these consultants felt the mass and all advised sedatives, rest and diet. These measures failed to bring relief and the condition gradually became worse.

On July 5, 1939, at 3 A.M. she had another attack of abdominal pain. She was seen by Dr. Maguire at 6 A.M. at which time he found her in moderate shock with pain more severe than he had seen her have before, and she had vomited several times. He administered morphine sulfate gr. ¼, and within an hour repeated the dose, bringing only slight relief. The mass which was present on this occasion was two or three times larger than when found before and did not disappear upon palpation as it had done routinely in the past. It was sausage-shaped and extended from the right upper quadrant to the pelvis. It was somewhat moveable and there was no additional pain upon gentle manipulation. Again at 10 A.M. another ¼ gr. of morphine was given and the pain was completely relieved. At this time, the mass seemed smaller. That night the pain became worse and the patient was removed to the hospital. Upon admission her temperature was 101.2°F., pulse 96, and respiration 24. A soap suds enema was given and returned with feces and a large amount of flatus, following which she was relieved and rested fairly well that night. The following day, the temperature was 99.6°F. and there was not much pain, the urinalysis was negative, hemoglobin 42 per cent, red blood cells 2,230,000, white blood cells 15,900, differential count normal, and

blood type 4 Moss. A large sausage-shaped mass filled the right half of the abdomen and extended over to the left side of the pelvis. It seemed smooth, soft and not especially tender to the touch.

A barium enema was given and an *x*-ray examination made. It revealed a normal appearing colon partly encircling the mass, which was almost in the midline at this time. The mass did not contain gas and did not look like an obstructed bowel. Under the fluoroscope, no additional information was gained. Barium was given by mouth and it could be seen that the stomach was separate from the mass. At this time the pain recurred, the patient vomited, and she was so distressed that the *x*-ray examination had to be abandoned for the time being.

Her general condition was very poor and yet she passed gas with every enema. We were not satisfied with the *x*-ray findings and wanted to repeat them, but her condition did not warrant it. We believed that we were confronted with a paralytic ileus, produced by a large retroperitoneal tumor which because of the fever present was possibly an infected right kidney. We thought two or three days of preparation might make the patient a better operative risk, especially so since the previous attacks had all subsided. She was given intravenous glucose, 2,000 cc. twice daily, and 500 cc. citrated blood. A Levine tube was inserted and a Wangensteen suction apparatus attached. This, with an occasional enema, gave symptomatic relief, but the mass did not change and the patient's general condition was not greatly improved. Her temperature varied from 99.6 to 103.6°F., and the following day her blood findings were: hemoglobin 50 per cent, red blood cells 2,120,000. However, on the next day, July 8 (two days after the *x*-ray examination), it was obvious that no improvement had occurred and that valuable time was being wasted. An immediate operation was decided upon.

Under local infiltration anesthesia, an upper right rectus incision was made. A large blue mass too large to be delivered appeared covered with peritoneum. Ethylene anesthesia was added, the incision enlarged and the mass delivered. It was found to be a thick, rubbery piece of intestine starting as an intussusception of the jejunum 10 cm. (4 in.) from the ligament of Treitz and involving a part of the ileum. It was about 15 cm. wide by 32.5 cm. long, and yet the mesentery was long enough, in spite of the edematous dense tissue, to permit the mass to be brought outside the abdominal cavity. Attempts to reduce it were futile, and upon

Fig. 3. *X*-ray appearance of stomach and small intestine, one year later.

slight pressure, the outer intestinal layer split, revealing another serous coat of peritoneum on the inside which was gangrenous and permitted a spill of intestinal fluid. Thereupon, it was obviously necessary to resect the entire tumor. After the tumor mass was removed and the mesentery sutured, the divided intestinal ends were united in an end-to-end anastomosis with fine silk for the inner layer and No. 00000 catgut for the peritoneal layer. The proximal end being only 10 cm. (4 in.) from the ligament of Treitz made this procedure somewhat awkward, but it was nevertheless accomplished with very little difficulty. The abdomen was closed without drainage and the patient returned to her room, with a pulse of 140, but otherwise in fair condition considering the extent of the operation. The time was one hour and fifteen minutes.

The following day the patient's condition was quite good. The temperature was 102.4°F., pulse 122, and respiration 20. There was remarkably little pain and very little opiate was required. On the fourth postoperative day, the Levine tube was removed and the patient began to retain fluids by mouth in small amounts, although the intravenous administration of fluids was continued at 3,000 cc. per day for the first six days. Following this she improved steadily, taking fluids by mouth and having daily bowel movements with the aid of enemas,

until July 26, two and one-half weeks later, when she developed a fever of 102°F. Upon vaginal examination a mass was felt in the pelvis, posterior to the uterus. Two days later, under ethylene anesthesia, a moderate-sized pelvic abscess containing colon bacillus pus was evacuated through the cul-de-sac. Since this infection must have occurred from the spill when the peritoneal coat split during the first operation, the surprising thing is that she did not get a general peritonitis or have earlier symptoms of the abscess. Following drainage of the abscess, she made a normal recovery and left the hospital on August 14, six weeks following admission, weighing eighty-four pounds. Upon examination July 10, 1940, one year later, the patient weighed 115 pounds and was in excellent health. She had no pain and no abdominal symptoms. The bowels were regular, there was no tendency to diarrhea and there were no nutritional disturbances. *X*-ray of the stomach following a barium meal, revealed normal findings.

Examination of the resected specimen showed that it consisted of nine layers of small intestine, that is, the intussusception was quadruple or "compounded" four times. It was 6 ft. 10 in. (205 cm.) long. There were no adhesions present between the layers of the intussusception and no evidence of tumor, polyp or other cause could be found, excepting that the mesentery was considerably longer than usual. There were large areas where the entire thickness of the wall was gangrenous, and the invaginated tissues were very edematous due to the long period of circulatory interference.

SUMMARY

1. Jejunal intussusception is largely found in adults. Its symptomatology is such that it can be diagnosed correctly preoperatively.

2. An additional case is reported, recurring in type, which necessitated a massive resection of 205 cm. of intestine.

3. No nutritional or metabolic disturbance has followed this resection.

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REGIONAL ENTERITIS*

REPORT OF TWENTY-ONE CASES

JOHN H. ECKEL, M.D. AND JOHN B. OGILVIE, M.D.
NEW YORK, NEW YORK

REGIONAL enteritis—more often called terminal or regional ileitis—was first described in 1932 by Crohn, Ginsberg and Oppenheimer,[1] and later Pemberton and Brown,[2] Mixter,[3] Homans,[4] Jackson,[5] and others have recorded their experiences with series of cases falling into this classification, and the more recent literature contains numerous series of cases, large and small, from all parts of the country. The purpose of this paper is to report our experience on the Surgical Service of the New York Hospital with this condition.

The classification of the cases of nonspecific granuloma of the small intestine by Crohn and his co-workers was a distinct contribution in the field of medicine as it called attention to a clinical entity now recognized by physicians and surgeons alike. Prior to 1932 only occasional cases which could be fitted into this group were reported, thus imparting the impression that the disease either occurs more frequently now or is being recognized more often than in the past. In all probability, many of the lesions were incorrectly diagnosed and classified as tuberculous enteritis.

Whatever the reason, since 1932 several large series of cases have been recorded. Crohn himself[6] up to 1938 had followed 110 cases personally; seventy-seven of these patients were subjected to operation. Pemberton and Brown[2] in 1937 reported thirty-nine cases from the records of the Mayo Clinic, and in thirty-six of these the diagnosis was substantiated by operation. In 1938 Mixter[7] reported twenty cases, as well as a summary of information obtained through an extensive questionnaire in which data on 363 cases were obtained from thirty-one individuals or clinics. Two hundred seventy-eight of these patients had been subjected to operation, with a mortality of 14 per cent and a recurrence rate of 20 per cent. The questionnaire revealed that the recurrences appeared within four months to six years. According to the collected opinions, radical resection in one or more stages was considered the treatment of choice in all but the acute stages of the disease.

In the earlier communications it was repeatedly stated that the lesion occurs chiefly in Semitics and is nonexistant in the Negro, this misconception arising from the fact that many of the series recorded came from hospitals caring chiefly for Jewish patients. In our series at the New York Hospital four out of twenty-one were colored and none was Jewish. Our statistics, however, confirmed those previously recorded in most other respects.

Since January 1, 1934, there have been twenty-one patients with regional enteritis admitted to the Surgical Service of the New York Hospital, thirteen of whom were females and eight males. Four Negroes were among the group. The disease was found most commonly in people in the third decade—eleven of our patients being between twenty-one and thirty years of age—the extremes noted being four and fifty-six years of age. The average age of all our patients were 27+ years. From this it appears that the age incidence of this condition corresponds with that of appendicitis, the disease with which it is most often confused.

Sixteen of our patients had had some complaints relative to the disease for over three months, four gave a history of three

* From the Department of Surgery of the New York Hospital, New York City.

TABLE I

Case	History Number	Age	Sex	Duration of Symptoms	Pain	Diarrhea	Nausea and Vomiting	Weight Loss, Lbs.	Abdominal Tenderness	Abdom. Muscle Spasm	Palpable Abdom. Mass	W.B.C.	Hgb.	R.B.C.	Blood in Stools	*X*-ray Findings
1. L. T.	21981	31	F (C)	3 days	+	+	+	25	+	+	o	10,500	98	.....	o	None
2. M. T.	175385	21	F (W)	2 mos.	+	o	+	o	+	+	o	12,500	95	.....	o	None
3. W. L.	176960	28	M (W)	3 wks.	+	o	+	o	+	+	o	17,850	110	.....	o	None
4. L. J.	192644	26	M (C)	4 days	+	o	+	o	+	+	o	9,800	108	.....	o	None
5. F. R.	206145	22	M (W)	4 mos.	+	o	o	o	+	+	o	12,500	100	.....	o	None
6. L. C.	223802	24	F (W)	12 hrs.	+	o	+	o	+	o	+	11,000	75	3.8 M	o	+
7. J. S.	106614	25	M (W)	6 days	+	o	+	+	+	+	+	16,000	95	.....	o	None
8. E. M.	125099	37	F (W)	10 hrs.	+	o	+	o	+	o	o	10,300	73	4.0 M	o	None
9. G. L.	185432	4	F (W)	3 wks.	+	o	+	o	+	+	o	14,800	76	4.0 M	o	None
10. E. G.	205989	20	F (W)	3 mos.	+	o	+	o	+	o	o	11,500	85	4.0 M	o	None
11. R. H.	265960	31	M (W)	13 mos.	+	+	+	35	+	o	+	8,900	92	5.2 M	o	+
12. J. J.	66854	14	M (C)	3 mos.	+	+	o	o	+	+	+	9,000	55	3.2 M	o	+
13. D. W.	46690	27	F (W)	2 yrs.	+	+	+	+	+	o	+	12,800	70	3.5 M	o	+
14. C. T.	146351	27	F (W)	3 yrs.	+	+	+	20	+	o	+	8,000	70	3.3 M	+	+
15. L. H.	171501	43	F (W)	3 yrs.	+	+	+	50	+	o	+	4,000	91	4.7 M	o	+
16. A. G.	199487	26	F (W)	3 yrs.	+	o	+	mod.	o	o	o	8,100	62	4.0 M	+	+
17. M. V.	230682	29	F (C)	8 mos.	+	+	+	30	+	+	+	9,500	100	4.8 M	+	+
18. A. D.	230447	29	M (W)	10 mos.	+	o	+	20	o	o	+	10,000	96	4.8 M	o	+
19. M. M.	216121	36	F (W)	6 mos.	+	+	+	40	+	o	+	12,000	83	3.7 M	+	+
20. S. B.	240588	56	F (W)	4 mos.	+	+	+	20	+	o	o	15,100	90	5.0 M	+	+
21. S. H.	230454	14	M (W)	3 mos.	+	o	+	5	o	o	+	8,300	85	4.3 M	+	+

or more years' duration, and one patient had pain for only twenty-four hours before admission.

The one symptom common to all cases was cramping pain in the abdomen. Nineteen had had nausea and vomiting at some time in their illness, and in the cases of longer duration this complaint was especially important. Weight loss was admitted by twelve patients in most cases of from five to ten pounds, though of greater degree in the more chronic cases. In one case weight loss amounted to fifty pounds. Seven patients complained of diarrhea without blood being noticeable in the stools; none of our patients had external fistulae.

X-ray studies in the form of gastrointestinal series and barium enemas were obtained in thirteen cases, leading to the diagnosis of regional enteritis or terminal ileitis in eleven. In two cases the *x*-ray studies were inconclusive, but the diagnosis was later proved at operation. The "string sign" was seen in six patients and was most easily visualized by means of barium enema. Alternate areas of dilatation and constriction of the small intestine were present in five patients.

ANALYSIS OF OPERATIONS

A summary of our operative procedures is found in Table II. There were twenty-four operations performed on twenty-one

TABLE II*

Operative Procedure	No. of Cases	Symptom Free	Unimproved	Postop. Mortality	Late Mortality
Simple exploration	2	1	1	0	0
Appendectomy	11	9	2	0	0
Resection with end-to-end anastamosis	4	2	2	0	0
Resection with lateral anastamosis	2	2	0	0	1 pt. died of carcinamatosis from ca. of cervix.
Resection with ileocolostomy (1 stage)	2	2	0	0	0
Resection with ileocolostomy (2 stages)	2	2	0	0	0
Enteroenterostomy	1	..	1	0	Pt. died of regional enteritis 6 mos. later.

* Twenty-four operative procedures performed on twenty-one patients.

On physical examination the outstanding finding was abdominal tenderness. This was present in 17 of our patients and was located predominantly in the right lower quadrant. Muscle spasm was found in nine patients; a mass palpable on abdominal examination was present in nine and by rectal examination in one. Slight to moderate distention was almost universally present. Occult blood was found in the stools of six of the eleven patients in whom this examination was carried out. The white blood count ranged from 4,000 to 17,000, the average being about 11,000. Five patients had hypochromic anemia with hemoglobin below 75 per cent. A low-grade fever was a common finding.

individuals without immediate postoperative mortality. Two of our patients on whom appendectomy was performed returned later for bowel resection, and one woman who had had resection performed suffered a recurrence, causing obstruction for which an enteroenterostomy was performed. One of our patients died at home nine months after resection from a recurrence of the disease, and one died six months after operation of metastatic carcinoma of the cervix.

Eleven patients presented a clinical picture simulating acute appendicitis with acute right lower quadrant pain, tenderness, muscle spasm and leukocytosis; two of these had a palpable mass. All eleven

were subjected to early operation and the terminal ileum was found to be reddened, thickened and hemorrhagic in each case. The mesentery was edematous and contained enlarged hyperplastic lymph-nodes and the operative procedure was limited to appendectomy and lymph-node biopsy. In the two cases with palpable masses there was no improvement until the patient was readmitted and radical resection was done. Eight of the ten of these eleven patients who have been followed are completely well six months to four years after operation.

It is usually stated that appendectomy should not be done in these cases since it predisposes to the formation of external fistulae, but to date we have not encountered this complication. On microscopic section the appendices presented an acute peri-appendicitis without mucosal involvement.

The group of cases subjected to radical resection presented symptoms suggestive of ulcerative colitis, with colicky pains, diarrhea (at times with blood and mucus), malaise, marked loss of weight, and in some instances fever. In addition, palpable masses and some degree of intestinal obstruction were found.

In four of the patients subjected to resection in which the lesion involved the terminal ileum exclusively, ileocolostomy and resection of the lesion was done either in one or two stages. All these patients have been well for from one to four years.

In the six remaining patients in whom a resection was done, a lateral anastamosis or an end-to-end anastamosis was done after varying lengths of jejunum or ileum had been removed. As much as 270 cm. of small bowel were removed in a fourteen year old boy, and 130 cm. have been removed in three other patients. Two of these six have not been aided by the procedure.

Two patients in this series were considered inoperable. In both, long segments of jejunum or ileum were involved and adherent to the rectum or bladder and their removal consequently were prohibited. One of these patients has subsequently recovered and the second to whom *x*-ray therapy was administered is unimproved.

CONCLUSIONS

Analysis of these cases suggests certain deductions as to the treatment of this condition:

1. A certain percentage of the patients with an acute condition will undergo spontaneous recovery or at least remain well for several years, the extent and duration of the recovery depending upon the amount of damage suffered by the bowel wall during the acute phase.

2. We must agree with previous reports that if improvement or a cure is to be anticipated in the patients with a chronic condition, a truly radical resection of bowel and mesentery must be done.

We have had insufficient experience in *x*-ray therapy to warrant any conclusions as to its effect.

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DYSCHONDROPLASIA OF THE DISTAL RADIAL EPIPHYSIS (MADELUNG'S DEFORMITY) WITH FUSION OF THE SEMILUNAR AND TRIANGULAR BONES*

HARRY H. ALEXANDER, JR., M.D. AND
Head of Orthopedic Department, Golden State Hospital
LOS ANGELES, CALIFORNIA

GILBERT H. JOHNSON, M.D.
Radiologist, San Joaquin Hospital
BAKERSFIELD, CALIFORNIA

DYSCHONDROPLASIA of the distal radial epiphysis is an uncommon affection of the wrist. It results from a failure of development of the medial portion of the distal radial epiphysis, while the lateral part of the epiphysis continues to grow.

This abnormal growth causes a dorsal and lateral bowing of the radius and thus the articular face of the radius is turned ventrally and medially. Because of the ventral growth of the articular surface of the radius, the head of the ulna appears prominent on the dorsum of the wrist, and the first impression is that one is dealing with a posterior displacement of the head of the ulna. A typical "bayonet" deformity of the wrist is present, giving the appearance of a central luxation of the wrist.

This deformity is usually bilateral, (128 out of 172 cases), and is found more frequently in females (4 to 1). A few rare "reverse" types have been reported—five in all.

Madelung first reported the condition in 1878. Since that time the majority of reports in the literature have appeared in foreign publications. Anton et al.[1] reviewed the entire literature to date, critically analyzing each published report. Some reports they discarded as not typical, or the condition described was due to injury, or the report was too incomplete to be acceptable. They entered into an exhaustive discussion of etiology, symptomatology and characteristic features. With their case report a total of twenty-one such deformities had been reported in the literature of this country. The reader is referred to this article for a review of the factors that make up this disease.

Thompson and Kalayjian[2] report five typical cases, one of which had a deformity at the elbow, in that the head of the radius was atrophied and distracted from the elbow.

Dannenberg et al.[3] report a case. They list twelve roentgenographic diagnostic criteria that should be met before the term dyschondroplasia of the distal radial epiphysis, as suggested by Anton et al., is applied.

Ghormley and Pollock[4] report the case of a woman, aged forty-two, in whom the deformity was bilateral, with a bilateral dislocation of the heads of the radii. The patient had an elder sister with a similar deformity. The patient's fifteen year old daughter's wrists had been thus deformed for two years. A nine year old daughter had not yet shown any deformities.

These reports bring the total of cases recorded in the American literature to twenty-eight. The following case of the authors' supplements this surprisingly small number, as well as adding an anomaly of the carpus not previously reported, although a fairly high frequency of other developmental abnormalities is reported.

CASE REPORT

Case No. D2088, M. McF., a colored female, age thirty, employed as a maid, first consulted one of the authors because of complaints of

* From the Orthopedic Department, Golden State Hospital, Los Angeles, California.

soreness in her left wrist and arm. She stated that on March 7, 1940, while working at her place of employment, she was washing a heavy iron stove burner. The burner slipped and struck her left wrist. She said this left wrist became sore that afternoon.

Past History. She was born and had lived in Texas until the age of twenty-six, when she came to California. She could remember nothing unusual about her childhood. She had mumps but no other childhood diseases and had had no other illnesses, accidents or injuries of any kind. She went to school through the seventh Grade. She said she did no work of any heavy nature until she began to do housework outside her home at about twenty-two to twenty-three years of age, and had been doing housework since. She was married at twenty-five but was never pregnant. She denied any trouble with any of her joints at any time. She said she had always noticed a prominence of the bones on the back of her wrists, but could not remember at what age she first noticed this prominence.

Physical examination revealed a colored, underweight female, apparently in no distress. Her temperature was 98.6°F.; pulse 120, blood pressure 142/86. Pupils were equal and regular and reacted to light and accommodation. The patient's nose was open; ears were filled with wax and drums were normal. Her teeth were in good condition, tonsils moderate in size, neck normal and thyroid not palpable. Her breasts were pendulous but there were no masses. Chest was normal to percussion and auscultation; heart was normal in size and no murmurs were present. The abdomen was scaphoid; liver and spleen were not palpable and there were no masses. A pelvic examination was not done. The lower extremities were normal.

There was a full range of active motion of both shoulders, elbows, all fingers and both thumbs. There was nothing abnormal about the upper extremities except the wrists. Both

FIG. 1.

FIG. 2.

FIG. 1. Anteroposterior roentgenograms of both wrists.
FIG. 2. Posteroanterior roentgenograms of both wrists.

wrists showed abnormal prominence of the heads of the ulnae, in all positions and to an equal degree. There was no swelling or thickening of soft tissues, or increased local heat. There was a tendency for both hands to be in some ulnar deviation, with the appearance of anterior luxation of the carpus. Active motions of the wrists were as follows:

	Left, Degrees	Right, Degrees
Flexion	58	60
Extension	31	40
Ulnar deviation	41	41
Radial deviation	0	0

There was full supination and pronation of both forearms. The circumferences of the arms were as follows:

	Left, Inches	Right, Inches
Biceps, flaccid	8½	8⅝
Biceps, contracted	9⅛	9⅛
Forearms	7⅞	8⅛

The patient was right-handed.

Laboratory Report. 80 per cent (13.5 Gm.) hemoglobin (Sahli); 4,020,000 red blood cells; 9,350 white blood cells. Differential: polymorphonuclears 36 per cent, lymphocytes 53 per cent, large mononuclears 8 per cent, eosinophiles 2 per cent; basophiles 1 per cent. Urinalysis of voided specimen: Straw color, alkaline reaction; sugar negative, albumin negative, acetone negative. Microscopic: 8 to 10 pus cells per high dry field. Blood Wassermann, Kahn and Laughlen tests, all 4 plus. Basal metabolic rate, plus 9.6.

Roentgenograms were made of both wrists in anteroposterior, posteroanterior, and lateral positions (Figs. 1, 2 and 3) and were interpreted as follows:

There is a bilateral deformity of both radii and wrists. There is an abnormally increased medial and ventral rotation of the articular faces of both radii. There is a prominence of the heads of both ulnae on the dorsum of the wrists. The carpal bones extend ventrally to meet the metacarpals which lie in the same plane as the bones of the forearm, making a bayonet-like deformity. There is noticed on the medial side of both radii, where they articulate

Fig. 3. Lateral roentgenograms of both wrists.

with the heads of both ulnae, an atrophic area where bone has failed to develop. Just above this area on both radii is a small spur. This deformity is due to a failure of proper growth of the medial half of the distal radial epiphysis and is known as dyschondroplasia of the distal radial epiphysis, or Madelung's deformity. There is noted a fusion of the semilunar and triangular bones bilaterally.

Treatment. No treatment for the deformity in this instance was indicated. Osteotomy usually of the cuneiform type has been advised when a correction of the curvatures of the radius is desirable.

SUMMARY

The writers have presented a case of bilateral dyschondroplasia of the distal radial epiphysis (Madelung's deformity) with fusion of the semilunar and triangular bones.

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MANAGEMENT OF TRAUMATIC MENINGITIS

E. S. GURDJIAN, M.D.
DETROIT, MICHIGAN

SULFONAMIDE therapy has been extremely effective in the management of meningitis. While the literature is large and still growing as concerns nontraumatic cases, there are very few articles on the subject of management of traumatic meningitis with sulfonamide derivatives. Allan, Mayer and Williams report on three cases of pneumococcic meningitis with recovery. One case was traumatic in origin. Finland, Brown and Raugh discussed ten cases of pneumococcic meningitis with three belonging in the traumatic group. All three patients recovered. Elvidge and Roseman discussed a case of recurrent traumatic pneumococcic meningitis with recovery. Neal, Appelbaum and Jackson describe thirty cases of pneumococcic and twenty-nine cases of influenzal meningitis. In the pneumococcic group there were three traumatic cases. Two of the three patients died. Ricard, Larget and Giraud described a single case of traumatic streptococcic meningitis with recovery, and a similar case is described by Narat. In summary, there are eight cases of pneumococcic meningitis and two cases of Streptococcus hemolyticus meningitis. In this group of ten cases there were two deaths, both in the pneumococcic group.

In the next few paragraphs three cases of traumatic meningitis will be reported briefly. In two, Streptococcus hemolyticus was isolated from the spinal fluid. In the third case, although no organisms were isolated and there was no growth on culture media, recovery with the use of sulfanilamide was spectacular. A brief résumé of the management of the patients is as follows:

CASE REPORTS

CASE I. S. R., age fourteen, entered Redford Receiving Hospital in an unconscious state following a bicycle accident on July 7, 1938 and was later transferred to Grace Hospital where he remained from August 1, 1938 to August 23, 1938. He had profuse bleeding from the right ear and cerebrospinal fluid discharge lasting about ten days. Five days after entrance he had an increase in temperature to 103°F., rigidity of the neck and some rigidity of all extremities. Spinal fluid revealed 3,600 pus cells per cubic millimeter. Hemolytic streptococci and some gram-negative bacilli were grown on culture.

The patient was given 80 gr. of sulfanilamide with sodium bicarbonate daily by mouth for two weeks. At times the drug was withheld for a day and a half to two days because of its unfavorable reaction on the patient. During his stay in the hospital he was given four blood transfusions, a total of 1,250 cc. of whole blood being given. Lumbar punctures were performed every day at first and every second and third day later. A high sulfanilamide level of 20.4 mg. per 100 cc. of blood and 17.2 mg. of spinal fluid was reached in the second week. The last spinal fluid examination, August 17, 1938, revealed twenty cells and the patient's condition was satisfactory. Since that time patient has done very well except for some conductive deafness of the left ear. The child seems to have no sequelae.

CASE II. N. B., age twenty-nine, entered Receiving Hospital on July 22, 1939 and was discharged on August 12, 1939. She was injured in an automobile accident following which she remained comatose for several days. There was bleeding from both ears. On the fifth day after entrance, July 27, 1939, the patient's temperature rose to 104.2°F. and at the same time there was rigidity of the neck and a positive Kernig reaction. The patient became somewhat irrational. The spinal fluid was cloudy with a slight yellow tinge and contained 4,600 polymorphonuclear cells. A total of 120 gr. of sulfanilamide with sodium bicarbonate was administered daily for ten days. No organisms were found on smear but on culture hemolytic streptococci were grown. The patient had several lumbar punctures with slowly receding

cell counts until on August 2, 1939 there were eight white blood cells per cubic millimeter. The sulfamilamide level ranged between 12.4 and 5.8 mg. per 100 cc. of blood. In one instance the spinal fluid sulfanilamide level was found to be 3½ mg. per 100 cc. The patient was given 500 cc. of blood on July 29, 1939 because of a secondary anemia (Hgb. 8.5, R.B.C. 2,870,000). She became improved clinically on August 6, 1939 and was quite asymptomatic on August 10, 1939. The drug was discontinued on Augut 8, 1939. During her illness the presence of bilateral sixth nerve paralysis was noted and she has shown no improvement up to the present time (October, 1940). This bilateral sixth nerve paralysis preceded the meningitic infection.

In the next case the usual findings of meningitis, namely, polymorphonuclear infiltration of spinal fluid, rigidity of the neck, increase in temperature were noted. However, on culture no organisms were grown. In this case there was a rather definite change in the symptomatology following the administration of the drug. Whether he was treated before normal growth of the organisms or whether this case represents an anaerobic type of streptococcus is a question. It is here reported because granted a patient with sudden increase in temperature associated with rigidity of the neck and a spinal fluid cell count of 2,000 or more pus cells per cubic millimeter, treatment has to be instituted whether organisms are found or not. If the instituted treatment happens to be followed by satisfactory results, it is reasonable to consider it partly responsible for the recovery.

Case III. J. P., age thirty-one, colored, entered the Receiving Hospital November 22, 1939 and was discharged January 1, 1940. The patient was admitted to the hospital after an effort to commit suicide by shooting himself. The wound of entrance was in the right anterior temporal region and the point of exit at the midforehead about one and one-half inches above the brow line. There was marked comminution and fragmentation of bone involving the right forehead. The patient was operated upon and fully two ounces of frontal lobe was found necrotic and destroyed. This was sucked away. The dura was badly torn in many directions but after the removal of the portion of the frontal lobe it was possible to effect some semblance of repair of the dural lining. Both frontal sinuses were badly comminuted and they were removed. The sinus as well as the dura were packed with iodoform gauze and the incision was closed in layers. Seven days after entrance into the hospital the patient developed a rigidity of the neck and a fever of 103.6°F. Lumbar puncture was performed which showed a turbid fluid with 4,800 W.B.C. (100 per cent polymorphonuclear cells). No organisms were found either on smear or culture. The patient was given 120 gr. of sulfanilamide with sodium bicarbonate daily for seven days. There was marked improvement in his condition clinically after the second day. Thereafter his temperature remained somewhat elevated for about one week although he seemed normal clinically. Blood sulfanilamide level ranged between 8.9 and 11.7.

COMMENT

In the management of head injury a complicating meningitis should be sought for as early as possible. At the onset of symptoms and signs, a lumbar puncture should be performed to study the spinal fluid, and if the latter is turbid and cloudy treatment with sulfanilamide should be instituted immediately. An initial dose of 40 gr. in the adult followed by 20 gr. every four hours can be given along with 2 teaspoonsful of sodium bicarbonate with each dose. Careful microscopic examination for the presence of organisms should be made. If the organisms are found, they should be classified and the treatment should be instituted based upon the type of infection. At the present time with the use of sulfonamide therapy streptococcic, staphylococcic, pneumococcic and meningococcic infection of the meninges may be treated successfully in most instances. If no organisms are found in the spinal fluid, sulfanilamide should be continued. While the patient is given the drug the spinal fluid

can be cultured for organisms. If on culture no organisms are found and if the administration of the drug has been followed by evidences of improvement, the drug is continued for many days, usually a week to ten days. Lumbar puncture every one to three days, daily white blood count, red blood count and sulfanilamide level of blood and if possible of the spinal fluid are in order. If secondary anemia supervenes a transfusion of whole blood or plasma may be given. Each of the three patients reported were given transfusions of whole blood during the course of their treatment. In the case of S. R., age fourteen, five transfusions of 250 cc. were given over a period of two and a half weeks.

In the above three cases, two adults and one child, 80 to 120 gr. of sulfanilamide were given daily. The drug was given orally most of the time. On occasions it was administered in saline, the drug going into a 1 per cent solution. Sodium bicarbonate was also given to combat acidosis. In these cases it was not necessary to inject the drug intravenously or into the spinal subarachnoid space. Probably none of them were allowed to go too far before the infection was noted and before the patients became moribund. Hence, it was possible to give the drug by mouth almost throughout the treatment. The blood sulfanilamide level was over 10 in all three cases tested. In Case 1 a high of 20.4 mg. per 100 cc. was noted on the sixth day. The spinal fluid sulfanilamide level was high in Case 1 (17.4) and rather low in Cases II and III (3.4 and 8.9). The clinical course of the patient seems more important than the sulfanilamide level of blood or spinal fluid in the treatment of traumatic meningitis. If the patient is carrying on satisfactorily and the usual dose of sulfanilamide is given, it is not necessary to become panicky because the drug level is too low. One reason for lower than actual levels may be the time at which the fluids are obtained in relation to the last dose of the drug, for the latter is easily excreted through the kidneys.

In the above reported cases two of the patients were proven to be infected with hemolytic streptococci. No organisms were isolated or grown on culture in Case III. That there was a meningitic infection and that the administration of sulfanilamide was followed by remarkable improvement in the clinical condition of the patient, there can be no doubt. Lack of growth on the culture media may have been due to the anaerobic qualities of the organism, or the early administration of the drug may have thwarted the growth of the offender.

It is not believed that a routine administration of prophylactic doses of the drug is proper; it may even be dangerous. One has ample time to treat the patient when symptoms and signs of meningitis supervene.

A word of caution is pertinent concerning the proper management of conditions in head injury to obviate intracranial infection inasfar as possible. The proper treatment of lacerations of the scalp, compound fractures, bleeding ears, pneumocephalus, cerebrospinal fluid rhinorrhea are in order. The fact that sulfonamide therapy is efficacious does not excuse improper management of cases of head injury.

SUMMARY

1. Three cases of traumatic meningitis treated with sulfanilamide are reported.

2. With early recognition of meningitis based on clinical and spinal fluid findings, sulfonamide therapy should be instituted at once. Oral administration of the drug is satisfactory.

3. The proper management of lacerations, compound fractures, blood and cerebrospinal fluid leakage from the ear and nose will obviate intracranial infection in the greatest majority.

4. Routine administration of the drug is improper and it may be dangerous.

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In all paralyzed muscles the circulation is very poor and frequently the limbs become cold and almost purplish in color. The use of supervised muscle training in the after-care of poliomyelitis, therefore, is the most important part of the treatment in restoring, partially or wholly, the function of the muscles. This can be made more effective if the circulation is good and the limbs are kept warm; massage can promote good circulation.

PYLEPHLEBITIS: RESPONSE TO SULPHANILAMIDE

JACOB S. BARB, M.D.
Adjunct Surgeon, Jewish Hospital
BROOKLYN, NEW YORK

THE widespread practice of early operation in acute appendicitis has made pylephlebitis, never very frequent, one of its rarest complications. Its incidence has been variously reported from 0.1 to 0.4 per cent. The rarity of portal phlebitis, associated as it is with metastatic liver suppuration, has been extremely fortunate since its surgical therapy has met with little success. Prophylactic ligation of the ileocolic vein beyond the point of thrombosis has accounted for some successful cases,[1] but portal vein ligation when the process has become further advanced has been uniformly fatal. The bactericidal properties of the liver have, in overcoming septic emboli, accounted for a few cases with spontaneous cure. Indeed, thrombosis in advance of the inflammatory process by sealing the hepatopetal vessel may also be a factor in checking the process. Early surgical drainage of accessible confluent liver abscesses has brought results in other cases, but in most cases multiple, small diffusely scattered abscesses are quite beyond the scope of surgical treatment. Thus, while not absolutely futile, the surgical therapy of pylephlebitis has been generally inadequate.

As a forerunner of greater success in treatment is the appearance of reports of a few cases in which the patients have completely recovered with sulphanilamide (Ottenberg and Berck,[2] Graham[3]). The actual value of any drug can be determined only after its prolonged trial in a great many cases. Because of the infrequency of the disease and since the drug has been in use only for the past few years, the accumulation of successful case reports will be slow. Indeed, this report was delayed in the interest of accumulating several cases, but this hope was not fulfilled. The purpose of this paper is to report, therefore, one additional case and to emphasize the apparently successful rôle of sulphanilamide in its therapy. The response to sulphanilamide is not surprising since the micro-organisms usually involved are colon bacilli and streptococci, both of these bacteria are generally susceptible to the action of the drug.

CASE REPORT

S. B., aged sixty-four, a white, male, appeared on the surgical service of Dr. Paul W. Aschner at the Jewish Hospital of Brooklyn on June 29, 1938, with the chief complaint of generalized abdominal pain of five days' duration. He gave a history of having been treated for a peptic ulcer for twenty years corroborated by *x*-ray examination. He had a suprapubic prostatectomy ten years before and a hemorrhoidectomy two years previous.

Five days before admission the patient was suddenly seized with severe periumbilical cramps. The pain persisted and was aggravated by an enema taken two days later. There was no nausea nor vomiting until the night before admission when it became continuous. There was no hematemesis or tarry stools. Nonbloody diarrhea appeared two days before admission and occurred five to ten times daily. He ran a fever as high as 102°F. There was no history of any chills.

On physical examination the temperature was 101°F., pulse 92, blood pressure 160/84. The patient appeared acutely ill and was hiccoughing and vomiting. There was moderate abdominal distention. The right lower quadrant was exquisitely tender with spasm, rebound tenderness and sensation of a mass. There was moderate tenderness in the upper quadrants. Borborygmus was absent on abdominal auscultation. The blood count on admission was as follows: white blood cells 10,200, polymorphnuclear leucocytes 74, lymphocytes 22, monocytes 4, hemoglobin 94 per cent, red blood cells 5,300,000. The urine showed a two plus

albumin with occasional casts. The diagnosis was acute appendicitis with local abscess. Perforated peptic ulcer was considered in the differential diagnosis. The former diagnosis was favored and operation was performed shortly after admission.

A right lower rectus incision was made and upon opening the peritoneal cavity, there was an escape of free, turbid fluid with flakes of fibrin and a foul odor. In the right lower quadrant, an inflamed, thickened, granular portion of omentum overspread several loops of small bowel and cecum, the bowel being covered with plastic exudate. On separating the omentum, several pockets of thick pus were encountered. The appendix was black, gangrenous, collapsed and as thin as tissue paper. The appendix ran downward over the pelvic brim and was adherent deep in the true pelvis.

The appendix was mobilized, the mese-appendix ligated and appendectomy performed without stump inversion. One cigarette drain was placed in the pelvis and one iodoform gauze pack at the appendiceal site.

Microscopic examination of appendix revealed the following: All the coats of the organ were the seat of a diffuse suppurative infiltration. Scattered throughout were numerous areas of necrosis. In the serosa, some of the vessels were filled with purulent thrombi. (Fig. 1.) A smear of the pus from the peritoneal cavity revealed gram-negative bacilli and gram-positive diplococci and streptococci. Bacilli pyocyaneus and streptococci were grown out on culture.

The patient ran a stormy course for the first week following which the temperature dropped to 100°F. The drains were removed on the seventh postoperative day and profuse drainage persisted for an additional week. On the tenth postoperative day the patient's temperature began to spike to 103°F. and at that time it was noted that the patient was jaundiced. The icteric index was 66 and bile was present in the urine. The liver and spleen were not palpable at any time. There was no tenderness over the liver but edema was present over the tenth and eleventh intercostal spaces in the posterior axillary line. On the twelfth postoperative day the patient was started on 80 gr. of sulphanilamide. Within forty-eight hours the temperature flattened to between 100 and 101°F. After nine days of sulphanilamide therapy, which was gradually decreased to 40 gr. daily, the temperature became normal and remained so for the week prior to the patient's discharge. Blood chemistry, taken three days after the onset of the sulphanilamide therapy, showed the icteric index to be 18.7 with a delayed direct Van den Bergh. Total cholesterol was 119 with 71 per cent cholesterol esters. The jaundice rapidly cleared so that it was no longer discernible on discharge.

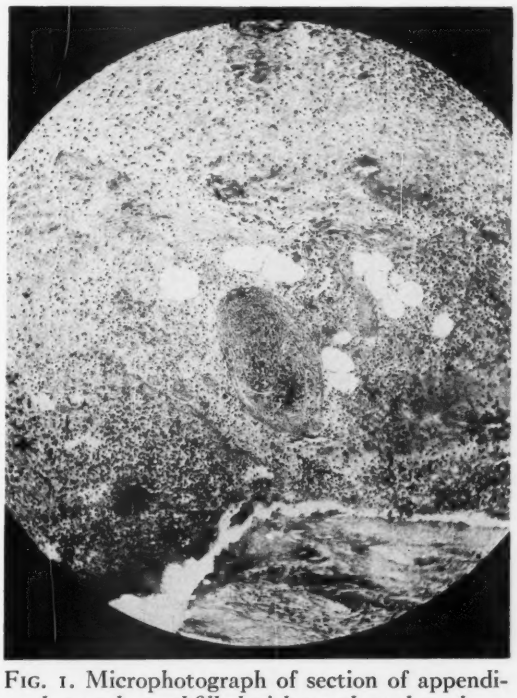

Fig. 1. Microphotograph of section of appendiceal serosal vessel filled with purulent thrombus.

COMMENT

There can be very little doubt that this was a case of suppurative pylephlebitis with metastatic liver involvement. The diagnosis is purely clinical and has not been proven by laparotomy or liver biopsy. However, the case presents the clinical appearance and the physical and laboratory findings to warrant this diagnosis. The microphotograph of one of the appendiceal serosal vessels filled with a purulent thrombus is cogent testimony to the focus of the infection. Indeed, the rapid response to sulphanilamide would seem to give added weight to the nature of the pathologic process in this case, as compared to the injurious effect it would have in a case of toxic hepatitis.

SUMMARY

This is a report of a case of pylephlebitis with liver involvement secondary to appendiceal thrombophlebitis. The case is added to the literature as an additional instance of successful sulphanilamide therapy. There does not appear to have been any reports of failure of this therapy, so that it is possible that in sulphanilamide we have a potent weapon against a hitherto fatal disease.

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Obesity is one of the most serious hurdles in the path of the poliomyelitic person. Many patients become obese from lack of activity or of diversion of thought, or possibly from stimulation or irritation of certain glands of internal secretion which are involved in growth and development . . . Weight reduction is accomplished by diet, exercise, endocrine therapy, and adequate intestinal elimination.

The brief excerpts in this issue have been taken from "Infantile Paralysis: Anterior Poliomyelitis" by Philip Lewin (W. B. Saunders Company).

HEMIPLEGIA FOLLOWING SPINAL ANESTHESIA*

REPORT OF A CASE

LEONID WATTER, M.D.
Attending Anesthesiologist, St. John's Hospital
BROOKLYN, NEW YORK

INTRODUCTION

THOUGH the recent literature on neurological sequelae of subarachnoid block is quite voluminous, there are very few reports on hemiplegias following this type of anesthesia. Our search of the medical literature of the past five years reveals but seven articles[1–7] dealing with this subject. Out of those seven articles, only two (both American authors) make the attempt to present their cases in the light of a modern conception of the etiology of such complications. Therefore, we believe that our case merits reporting, not only for its relative rarity, but also for an opportunity to restate this new interpretation of causative factors.

CASE REPORT

Mrs. G. V., age forty-three, a white, native American, on November 22, 1938, was admitted to the private service of Dr. Fisher with a complaint of meno- and metrorhagia of three years' duration. For the past five months she had noticed increasing weakness and fatigue. Her family and past history were essentially negative except for diphtheria in early childhood and two attacks of rheumatic fever at six and seventeen years of age without any known complications. Systemic review was negative. Menses began at twelve years of age. She was married at eighteen years and had no pregnancies. Physical examination: pulse 64, respirations 20, temperature 99.2°F., blood pressure 138/80. The patient was a fairly well developed and well nourished woman of middle age who gave the impression of being chronically ill. Skin and lips were very pale, so were the conjunctivae and the mucous membranes of the mouth. Otherwise the physical examination was essentially negative. *Laboratory data:* urine negative except for one plus albumin. *Blood:* hemoglobin 46 per cent, erythrocytes 3,250,000, leukocytes 6,000 (neutrophiles 81 per cent, lymphocytes 18 per cent and eosinophiles 1 per cent). Red blood cells showed a marked central pallor, some polichromatophilia and moderate poikilocytosis and anisocytosis. Serology was negative. The diagnosis was fibroid uterus with secondary anemia. After two transfusions (November 23 and 25) amounting to 875 cc. her hemoglobin rose to 81 per cent and the erythrocytes to 4,370,000. Both times the indirect method was used and there was moderate reaction following the second transfusion.

She underwent operation on November 28, when a supracervical hysterectomy with appendectomy was performed. The operation lasted forty minutes and the patient left the operating room in good condition save for a low blood pressure of 60/45. The anesthetic consisted of a mixture of 150 mg. of neocaine with 1.5 mg. of 1:200 nupercaine solution injected into the fourth lumbar interspace. The spinal tap did not present any technical difficulties. The only untoward result noticed during the operation was a severe drop in blood pressure immediately after the injection of the anesthestic mixture. The pressure fell to 70/40 and the patient began to show signs of moderate spinal shock manifested by pallor and persistent nausea. To counteract these symptoms the patient received a continuous inhalation of oxygen. No vasoconstricting agents were used at any time before or during the operation. The pressure remained extremely low throughout the operation: 70/45, 60/45 and 55/45. The preoperative medication consisted of 1½ g. of phenobarbital the evening preceding the operation and one tablet of HMC #1 (morphine sulphate gr. ¼, hyoscine hydrobromate gr. 1/100 and cactoid gr. 1/60) one hour and a half

* From the Surgical Division of St. John's Hospital, Brooklyn, New York. John E. Jennings, M.D., Chief of Service.
Read before the Monthly Meeting of the Professional Staff of St. John's Hospital, February 4, 1941.

prior to operation. At no time did the patient show any signs of being oversedated.

Postoperative Course. It was noticed the following day that the patient had not spoken since the operation. In addition, it was observed that she did not move her right side. One day later she began to show signs of a facial paralysis on the right side. On the same day (November 30) she was seen by Dr. Bondar in a neurological consultation. His findings were as follows: "History of long standing secondary anemia from loss of blood. At present patient has complete aphasia, moderate sensory right-sided hemianesthesia and analgesia and flaccid right-sided hemiplegia with Babinski, Chaddock, Oppenheim and Schaefer on the right. Cranial nerves are all normal except right central facial weakness with drooling from the right side of the mouth and sensory changes over the right side of the face. Left fundus visualized—disc within normal limits. Right disc not seen. Although patient is conscious and apparently alert, there is no response to questions or commands. Impression: Cerebral thrombosis left hemisphere involving supramarginal gyrus, pre- and post-Rolandic gyri. In view of the progressive signs prognosis is extremely guarded." On the following day (December 1) in addition to her other signs, patient had a stiff neck. However, she seemed to be somewhat brighter and was trying to speak. During the following week her condition remained practically unchanged except that on the seventh day she was able to take fluids through a glass tube held in the right side of the mouth.

On December 6 she underwent another neurological examination by Dr. Feinier, whose findings were essentially similar to that of Dr. Bondar. Dr. Feinier believed that the patient had suffered a vascular accident, a thrombosis of a branch of the left middle cerebral artery. He also thought that the patient was improving. On December 13, the patient was again seen by Dr. Feinier, who noted the following progress: "Patient is now able to speak—is able to repeat words and can talk spontaneously. No movements have been noted in right upper extremity. The right facial is slightly less pronounced. Right Babinski positive. Right-sided deep reflexes present. Responds to pin-prick on the right."

The progress of her recovery was very slow. She was able to move her arm on December 16. The sign of Babinski was gone on the twentieth. On December 24 she was able to take a few steps. On the twenty-seventh she walked to the bathroom and was able to flex and to extend fingers of right hand. After a forty-eight day hospital stay she was discharged on January 15, 1939, as improved with right hemiplegia and aphasia still present. At present her condition is practically normal except for marked changes in her personality. Instead of being a very capable, energetic woman, occupying a responsible position, she shows now many childish traits. Her intelligence has undergone considerable retrogressive changes and she is entirely dependent at the present time.

GENERAL COMMENT

Hitherto, the usual approach to the neurological sequelae of spinal anesthesia has been made from three fundamental standpoints in regard to their etiology, namely, infection, trauma and the toxicity of the drug. For the majority of such cases this interpretation has been found sufficient to explain the pathology and to account for the clinical manifestations of such complications as the syndrome of the cauda equina or conus medularis, myelitis, asceptic meningitis and meningoencephalitis. But it was much more difficult to explain on such grounds complications that dealt with cerebral damage only, and where at no time were any indications of an involvement of the spinal cord or its meninges found. It is at the present time generally accepted that the cerebral complications of inhalation and even local anesthesia are the result of an anoxia occurring during the time of anesthesia.[8,9] The anesthetic agent per se has nothing to do with them. A similar interpretation for the purely cerebral complications of spinal anesthesia must be admitted. That such an approach is debatable is shown by the fact that both neurologists, who have seen our case, have expressed their opinion that a thrombosis was the cause of this accident. We question this diagnosis and suggest a selective anoxia of the brain as the cause of a focal necrosis of the cortex.

The damaging rôle of anoxemia and tissue anoxia so often associated with spinal anesthesia is still insufficiently stressed. Moreover, it is insufficiently understood. For a better elucidation of our point of view a brief discourse on some fundamental physiological and pathological manifestations of spinal anesthesia is in order. Profound circulatory and respiratory changes take place in spinal anesthesia.[10] A loss of the skeletal muscle tone and the paralysis of the vasconstrictor nerves of the anesthetized area result in an increased vascular bed. This leads to a low blood pressure, diminished minute volume flow of blood and poor oxygenation of the tissues. Circulation time becomes greatly increased[11] and the condition of stagnant anoxia results.[12] Inasmuch as the integrity of the brain and heart is closely interwoven with an adequate supply of oxygen, an insufficient flow of blood through central respiratory mechanism secondary to cardiovascular depression may spell diaster, even without the necessity of an actual respiratory or cardiac failure A paradoxic asphyxia of the tissues can develop even in the presence of an abundant supply of oxygen if the depth of respiration is insufficient to effect washing out of carbon dioxide from the venous blood. In the cases which came to necropsy, embolism or hemorrhage very seldom were found and the histological changes in the brain were strikingly similar to those found in animals subjected to death from asphyxia. These changes also bore a close resemblance to the lesions found in asphyxia after general anesthesia and consisted mainly of areas of focal necrosis of the cortex. The alteration in the globus pallidus were more pronounced after spinal anesthesia.[13] The unilateral brain damage such as is observed in hemiplegias can be explained on the grounds of extremely common individual variations in the pattern of the vessels arising from the circle of Willis and supplying the two halves of the cerebrum.[14] The cells of the cerebral cortex exhibit not only a peculiar sensitivity to the lack of oxygen but also a peculiar tendency to degeneration of certain layers. This is probably due to the local disturbances in the cerebral circulation: the poorer the blood supply, the greater the degree of cellular damage.[15]

While practically in every spinal anesthesia we encounter a drop in blood pressure with associated anoxia of various degrees of intensity, the question arises why such postspinal encephalopathy does not occur more frequently. The answer lies in the complexity of the causative forces involved. Anoxia produced by spinal anesthesia is but the final precipitating factor.

At least two additional factors deserve consideration, namely, a histotoxic anoxia and a latent impairment in cardiocirculatory efficiency. In histotoxic anoxia the cells are so damaged that utilization of oxygen becomes greatly handicapped. The main cause of such catabolic type of anoxia is excessive use of preoperative medications. This factor is especially stressed by Schreiber[16] who is greatly impressed by the number of cases of altered personality following spinal anesthesia. He attributes such cerebral degenerative changes to the excessive use of such histotoxic agents. It is quite obvious that superimposition of the stagnant anoxia of spinal anesthesia on existing histotoxic anoxia may spell disaster in certain cases.

As to the factor of latent impaired cardiocirculatory efficiency, its importance in the cerebral complications following all types of anesthesia is greatly emphasized in the recent papers by Behrend and Riggs.[17] In such conditions as organic heart disease, anemias, metabolic disorders such as diabetes mellitus or hyperthyroidism, a chronic circulatory inefficiency may exist which under ordinary circumstances gives no clinical evidences of its presence. Under the added stress of spinal anesthesia, with its great demand on the reserve power of the cardiovascular system—for that matter any additional demand on this system—a circulatory breakdown may take place and precipitate cerebral changes, such as psychoses, convulsions, paralysis or even death.

In our cases, all the aforementioned factors were present: chronic anemia, heavy premedication and severe drop in blood pressure following spinal anesthesia. In addition, the patient being a redhead, even a peculiar vasomotor make-up may be suspected.

SUMMARY

A case of a right-sided hemiplegia with aphasia following spinal anesthesia is presented and the rôle of stagnant anoxia as the precipitating factor of such a complication is discussed.

I wish to thank Dr. S. Lloyd Fisher for his permission to report this case.

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TRAUMATIC RUPTURE OF NORMAL SPLEEN WITH DELAYED HEMORRHAGE

REPORT OF A CASE

DAVID W. FEY, M.D. AND IRVING L. TUROW, M.D.
Consulting Surgeon, Peoria State Hospital — Associate Member of Staff, St. Francis Hospital
PEORIA, ILLINOIS

THERE is a marked difference of opinion concerning the relative frequency of traumatic rupture of the spleen. Mazel[1] reports that rupture of the spleen occurs in 30 per cent of subcutaneous injuries to the abdominal viscera. Bronaugh[2] reports 33 per cent, Wright and Prigot[3] and Connors[4] show that the spleen is involved in 47.6 per cent of cases of pathologic conditions of the viscera due to subcutaneous injury.

The automobile is the traumatic agent in the greatest number of cases. Falls are second in frequency. In the age group the incident is greatest in children up to the age of ten and then in the final age group from forty to sixty.

Wright and Prigot[3] divide the cases into five clinical types dependent upon the rate of hemorrhage: (1) Massive hemorrhage, causing immediate or sudden death; (2) acute hemorrhage, producing shortly after the injury a state of shock which rapidly becomes deeper; (3) repeated small hemorrhages. The patients enter the hospital in good condition but show signs of slow, progressive hemorrhage, increasing anemia, a rising pulse rate, fall in blood pressure and progressive weakness. (4) Late hemorrhage. The patients have an initial injury from which they recover. After a period of relief from symptoms they suddenly go into shock, showing signs of acute internal concealed hemorrhage or they may have a recurrence of signs and symptoms of repeated small hemorrhages. They may gradually become worse, showing signs of increased hemorrhage over a period of days or weeks. (5) Spontaneous cure. The patients show no signs of hemorrhage and suffer only localized pain, which soon disappears. The only one of these groups with which we are concerned in this paper is the late hemorrhage, as the case reported falls into this class.

In this group of cases the period of symptomatic relief is called the latent period. This period is terminated by some minor incident, such as straining at stool, or a muscular spasm, or for no apparent reason as in our case. The second hemorrhage may not show the acute symptoms of blood loss but may have a slow insidious onset.

CASE REPORT

A white male, fifty years of age, had engaged in an altercation and a physical examination made immediately afterward revealed tenderness over the tenth rib at the left anterior axillary line and a contusion of the skin on the right side of the chest. Fluoroscopic examination of the chest revealed no abnormal findings. The injury was then considered a bruise to the soft tissues and not serious.

The patient was symptom free for six days following this incident. On the seventh day the patient became acutely ill. Observation revealed him to be lying in bed and in an apparent moderate amount of pain. He complained of pain in the epigastric region, the left shoulder, left arm and the left side of the neck. The essential physical findings were as follows: The abdomen was flaccid, but there was a definite point of tenderness in the epigastric region. Codeine gr. ½ and aspirin gr. 5 were administered and an s.s. enema given following which the patient appeared to be more comfortable and went to sleep. Three hours later the patient had an emesis of clear vomitus follow-

ing which he went to sleep. Symptoms of acute distress became manifest five hours later. Examination at this time revealed the abdomen to be slightly distended and with marked rigidity over both upper quadrants. He lay on his left side with his knees flexed on his abdomen, stating that this was the position in which he felt most comfortable. The erythrocyte count was 2,790,000; hemoglobin 48 per cent, and the leucocyte count 21,100 per cubic millimeter. The urine was normal. Blood pressure was 100/60; the pulse 140 and feeble, temperature 96°F., respiration 36. The abdominal pain was generalized. A diagnosis of ruptured viscus, probably the spleen, with severe hemorrhage was made and the patient prepared for surgery.

The abdomen was opened under spinal anesthesia and after incision of the peritoneum the abdominal cavity was found to contain a very large amount of dark red blood. Examination of the spleen revealed a subcapsular rupture along the greater curvature. A splenectomy was performed and the abdomen was closed. The duration of the operation was twenty minutes.

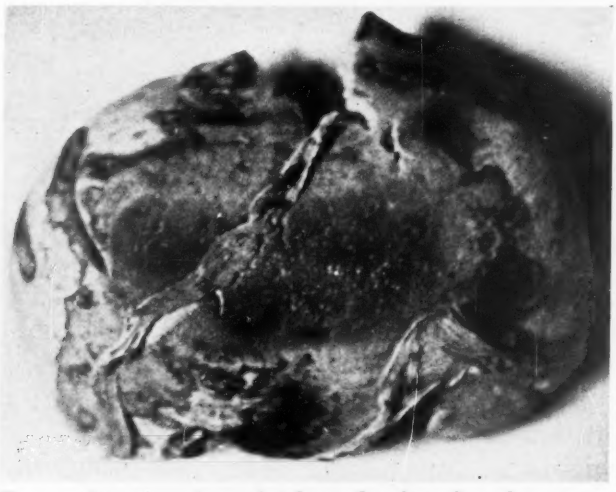

Fig. 1. Anterior view of spleen showing site of rupture.

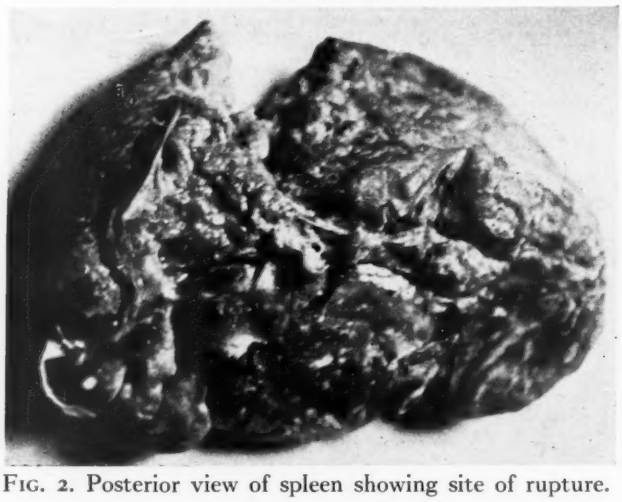

Fig. 2. Posterior view of spleen showing site of rupture.

Immediately following surgery the patient received 350 cc. of citrated blood intravenously and 10 per cent glucose by the continuous intravenous drip method. A total of 700 cc. of blood was administered by transfusion.

On the fifth postoperative day the patient developed a left lobar pneumonia. Polyvalent serum was administered and his condition immediately improved. Convalescence from then on was uneventful and the patient was discharged from the hospital on the fourteenth postoperative day. Following discharge from the hospital, blood findings were as follows: White blood count 12,000 per cubic mm.; red

blood count 3,350,000 per cubic mm.; hemoglobin 60 per cent; platelet count 350,200 per cubic mm.

McIndoe[5] reports forty-six cases of late hemorrhage which occurred in patients between the ages of eight and sixty-three.

The pathological changes which occur in late hemorrhage may vary from a minor superficial capsular rupture with ecchymosis and slow hemorrhage; or there may be intrasplenic hematoma and subcapsular hemorrhage with subsequent capsular rupture; there may be a capsular and parenchymal rupture with an encapsulated perisplenic hematoma and the omentum tends to wall off this lesion.

The minor superficial ruptures are usually small fissures. The severity of the hemorrhage is not determined by the depth of the rupture but the importance of the vessels sectioned. For this reason fissures in the region of the hilum are more likely to produce severe hemorrhage and show the least tendency to localization. Many of these heal rapidly by simple scar formation. (Fig. 1.)

In cases in which there is an intrasplenic hematoma and subcapsular hemorrhage with subsequent capsular rupture there is usually a diffuse or localized subcapsular hemorrhage or more deeply placed hematomic formation. If, however, the capsule remained intact, the intrasplenic hemorrhage assumes large proportions, limited only by the tensile strength of the capsule.

Where there is a capsular and parenchymal rupture with formation of perisplenic hematoma, the lesions vary widely. The convex surface and posterior border are most frequently involved. In most cases of this type the omentum has been found to be blackened, swollen and infiltrated with old blood and plastered over the area of rupture.

The symptoms and signs of rupture of the spleen are those of hemorrhage, shock and diaphragmatic irritation. Abdominal pain is found in practically every case. It may vary from discomfort and dull aching to severe, stabbing paroxysms. It is usually sharp, lancinating and localized in the left upper quadrant. Very frequently there is a radiation to the left shoulder. Dyspnea occurs and is probably due to diaphragmatic irritation, injury to chest wall or acute loss of blood. The most constant of the physical findings is abdominal rigidity and tenderness which is generalized at first, then localized to the epigastrium or left upper quadrant. There are varying degrees of tenderness over the splenic area, the left costovertebral angle and the base of the left side of the thorax. Shock is evident from the rapid, thready pulse, low blood pressure, low pulse pressure, the clammy skin, pallor, cold extremities and shallow respiration. The red blood count and hemoglobin values are usually lowered, especially can this be noted after repeated determinations.

Abdominal tap has been found to be of considerable aid in the diagnosis of subcutaneous injury of the abdominal viscera according to Wright and Prigot[3] who report its use in fifteen cases of rupture of the spleen in which it gave positive results in thirteen. It is their opinion, however, that if abdominal tap gives negative results and the patient continues to show signs of concealed hemorrhage, the tap should be repeated.

In the differential diagnosis it must be remembered that contusion of the abdominal wall presents a similar picture of that of subcutaneous splenic rupture, except that in contusion the pulse rate, red blood counts and blood pressure are generally normal. Fracture of the lower ribs or left side with shock produces a similar picture. Very frequently fracture of these ribs is associated with rupture of the spleen.

Perforated peptic ulcer is the most commonly confused condition, probably because no history of trauma could be obtained from the patient. Cases have been reported in which this condition has been confused with acute appendicitis,[6] ectopic pregnancy,[7] cholecystitis,[8] rupture of left kidney or liver, traumatic pleurisy and rupture of a gastric ulcer.[9]

In the preoperative treatment it is of greatest importance to institute means to combat the shock. Gum acacia should be given intravenously by the slow drip method while blood is being obtained for transfusion. When the blood is available it should be given by the slow, continuous drip method and continued during the operation. It is important that no patient suspected of having a ruptured spleen be given a preoperative enema because the clot formed in the spleen is very friable and may easily be dislodged by any muscular effort such as straining at stool.

The treatment is always surgical and splenectomy is the operation of choice but tampanade has been used. It is condemned because it is uncertain; the bleeding may not be controlled and even should it be successful the resulting abdominal wound is frequently weak. McIndoe[5] advises against its use.

Rieweues, in 1892, performed the first recorded splenectomy for traumatic rupture. The operation may be performed through the wide transverse left subcostal incision of C. H. Mayo or through the upper left rectus incision of Bevan and Balfour. Injury to the pancreas must be carefully avoided as this may result in the formation of a pancreatic fistula or may cause digestion of the edges of the wound with eventual evisceration.

The removal of the spleen has not been found to produce any ill effects. The spleen is a part of the reticulaendothelial system and after its absence the remainder of the system assumes its functions. Also, accessory spleens are much more common than is believed. Curtis and White[10] report accessory spleens in 10 per cent of cases in which autopsy is performed. They are more common in infancy and tend to disappear with age.

SUMMARY

1. A case is presented in which delayed hemorrhage from a ruptured spleen occurred seven days following original spleen injury.

2. During the latent period some healing takes place in the spleen.

3. The mortality is the same in delayed hemorrhage as it is for splenic rupture in general.

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REMOVAL OF A CEREBRAL MENINGIOMA IN A PATIENT WITH SEVERE CORONARY HEART DISEASE*

ABRAHAM KAPLAN, M.D.
Associate Neurosurgeon, Mt. Sinai Hospital
NEW YORK, NEW YORK

A MAJOR operation in a patient with severe coronary heart disease is usually undertaken with great anxiety and considerable misgivings. Not only is one uncertain whether the cardiac reserve will withstand the added burden of an operation, but one is even more concerned with the probable precipitation of a coronary closure incidental or accidental to the operation.

However, it is interesting indeed and very encouraging to learn from Brumm and Willius,[1] that coronary heart disease should not be a deterrent factor in performing any major operation. In their study of 257 patients with severe heart disease, who were subjected to major operations at the Mayo Clinic there were only eleven deaths. or 4.3 per cent. It is also significant, that the average age of the entire group was 60.3 years. Only one of the 257 patients had a craniotomy, and that for a pituitary neoplasm.

From a somewhat different point of view Master, Dack and Jaffe[2] studied 625 seizures of occlusion of the coronary artery at Mt. Sinai Hospital. Thirty-five of this number (5.6 per cent) occurred following a major operation in the hospital.

Of the 295 intracranial meningiomas in Dr. Cushing's monograph[3] there was not a single instance complicated by coronary heart disease. It seems, therefore, important to record the experience of a favorable outcome in a patient who had a benign cerebral neoplasm complicated by coronary heart disease.

CASE REPORT

L. B., a forty-two year old garage owner, was first admitted to Mt. Sinai Hospital on November 25, 1938, because of right-sided convulsions. In his past history it is noteworthy that seven years previously he received a blow

FIG. 1. Downward displacement of left lateral ventricle without shift of third ventricle; absence of subarachnoid markings over left hemisphere.

to the left side of the head. There was no loss of consciousness and for a day he had headache. Three years before admission he fell on the ice, struck the left side of the head and lost consciousness for several minutes. Six months following the second injury he began to experience dull frontal headache, coming about once a week and lasting about one to two hours. For the next two years the headaches gradually increased in severity and frequency, but were easily controlled with aspirin. Six months before admission he noted numbness of the right side of the tongue, which was followed by twitching of the right side of the face. This lasted about three minutes and was not accompanied by loss of consciousness. One week later

* From the Neurosurgical Service of Mt. Sinai Hospital, New York City.

he had a similar seizure. The teeth were suspected as an offending focus, and all were very promptly extracted. Within the following two

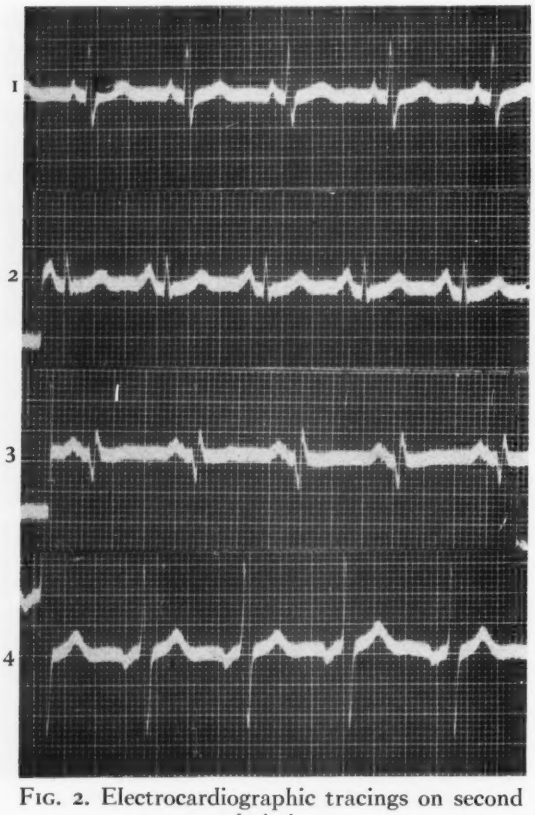

Fig. 2. Electrocardiographic tracings on second admission.

months he had six similar seizures. These had the added features of slight transient weakness of the right hand and numbness of the fingers.

Three weeks before admission he had two severe convulsions, one following the other. They were ushered in with numbness of the right side of the tongue, twitching of the right side of the face and right arm, each lasting about ten minutes. There was no loss of consciousness or sphincter control. However, he was unable to move the right arm until the next day. In between attacks he had no headaches.

For one and one-half years before admission he had been troubled with attacks of gripping precordial pain, radiating down the left arm. Moderate exertion caused dyspnea and often precipitated an attack of precordial pain. He coughed frequently and was unable to do any work.

The patient appeared plethoric, and there was evidence of mild bilateral exophthalmus. The heart was enlarged to the left; blood pressure systolic 120, diastolic 90.

Electrocardiogram by Dr. A. M. Master

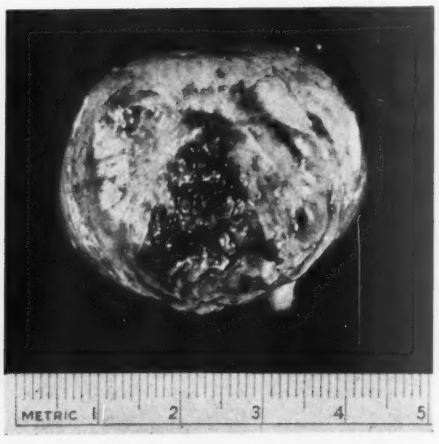

Fig. 3. Meningioma with adherent dura.

showed regular sinus rhythm (70–75), unusual axis deviation, and deep QIII wave. Several days later the E.C.G. showed T3 semi-inverted.

Abnormal neurological findings were indeed very few. The right corneal reflex was diminished; there was a suggestive right facial weakness, some drifting of the right arm and the deep reflexes were somewhat more active on the right.

Almost all concurred in the view that the patient had severe coronary heart disease and that it was questionable whether encephalograms should be done, for in any event it was doubtful whether surgery would be undertaken.

Nevertheless on December 20, 1938, encephalography was performed, which showed a downward displacement of the left lateral ventricle. The right lateral ventricle was somewhat larger than the left, but both were dilated. The third ventricle appeared in the midline and was of normal size and configuration. However, the subarachnoid markings over the left hemisphere were less distinct than those on the right. (Fig. 1.)

On December 23, 1938, the patient was discharged and advised to continue with luminal therapy.

Second Admission August 1, 1939. In spite of medications the convulsions continued as previously. The right-sided Jacksonian seizures with the sensory component recurred on the average of once every fortnight. For three months, however, there were additional symptoms of electric-like sensations spreading from

the right side of the face to the trunk and right hip. In addition there was numbness and paresthesia of the fingers on the same side. With the termination of a convulsion he noted extreme exhaustion, weakness of the right side of the body and temporary speech disturbance.

There was no demonstrable change in the neurological status. Roentgen films of the chest showed marked enlargement of the heart, particularly hypertrophy and dilatation of the left ventricle.

Electrocardiogram by Dr. A. M. Master showed left axis deviation, QIII was deep, and Q R S was of low amplitude in lead II. (Fig. 2.)

The patient was about to be discharged for the second time, when he began to plead to be operated upon, stating that he would prefer to die of the operation than to have another convulsion.

The risks of the operation were again explained, also it was made clear that a two-stage procedure might be necessary, all of which he accepted unequivocally.

Operation. August 15, 1939. Under avertin and local novocaine anesthesia a frontoparietal craniotomy was performed. In reflecting the scalp and bone flap, there was moderate bleeding, but not sufficient to register any notable change in pulse or blood pressure. It was, therefore, decided to proceed further. As the dura was opened and reflected toward the longitudinal sinus, there came into view a well demarcated neoplasm about the size of a large plum, which was intimately attached to the undersurface of the dura. The vessels entering the neoplasm were clipped and severed and with gentle brushing the tumor was tilted out of its bed. (Fig. 3.) The dura overlying the tumor was completely excised. After careful hemostasis the dura was closed, and some Cargile membrane placed over the dural defect. The wound was then closed in layers.

At the close of the operation the blood pressure was 60 systolic and 40 diastolic. The patient was not moved from the operating table. Within the next hour the pulse became imperceptible, the blood pressure could not be recorded, the patient became cyanotic and there was a cold perspiration over the entire body. A transfusion of 250 cc. of citrated blood was started promptly and within twenty minutes there were unmistakable signs of improvement. Nevertheless he was kept on the operating table for four hours longer, and then very cautiously transferred to bed and to his room.

From then on the postoperative course was unusually smooth. One week after operation he was out of bed.

On August 29, 1939, a fortnight after the operation he was discharged, symptom free and with no abnormal neurological signs. He is back at work, performing light duty, and still experiences precordial distress, which is not as disabling as before operation.

SUMMARY

A report is made of a patient, who had both severe coronary heart disease and a nonmalignant intracranial neoplasm. Operation at first was deferred, but with full realization of the risk involved, the operation was carried to a successful conclusion.

This single experience is also in keeping with the recorded experiences in the literature, that coronary heart disease should not be a deterrent factor in performing any major operation in which the indications are perfectly clear.

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New Instruments

PNEUMATIC AND ELECTRIC POWER UNITS MODIFIED FOR PRACTICAL USE IN NEUROSURGERY*

RUPERT B. RANEY, M.D. AND AIDAN A. RANEY, M.D.
LOS ANGELES, CALIFORNIA

WHILE the fundamental principles of neurosurgery have advanced rapidly, the development and refinement of instruments, especially for bone cutting purposes, have shown little progress since the advent of the specialty. The osteoplastic flap is, in general, elevated with the same instruments employed more than half a century ago, i.e., the hand brace with perforators and burrs, the Gigli saw and the DeVilbiss rongeur. This procedure with these instruments is, to say the least, not only a laborious task but exceptionally time-consuming.

Interestingly enough, mechanically powered tools have been developed in industrial fields of endeavor to a high degree of efficiency and with advantages far surpassing those of antiquated hand instruments; e.g., mechanically powered drills used for delicate work in the steel, stone and wood industries. Needless to say, the proper modification of time-tested mechanically powered tools to suit the conditions encountered in neurosurgery can be expected to be, and are, equally efficient in labor saving and time consumption. Thus, labor and time, both of which play a prominent part in surgical shock, are favorably influenced.

In the past, several have attempted to harness power units equipped for bone cutting purposes. Such units, however, have not become universally popular because of numerous disadvantages, viz.: (1) sterilization difficulties; (2) uncontrollable power endangering the underlying nervous system, or even at times, the surgeon; (3) excessive vibration which in turn is transmitted to the patient's already compromised nervous system; (4) awkward handling features; and (5) excessive bulk and weight.

During the last seven years the writers have modified, tested and used various types of power units, both air turbines and electric motors. The air turbine is light (nine ounces) and handles with ease, gives adequate power, and delivers high speed (40,000 to 65,000 revolutions per minute) which is essential for bone cutting purposes. Heating of the bone does not occur if a small amount of normal saline solution is applied to the burr during the cutting process, and at such speeds tiny burrs actually appear to incise bone. The average osteoplastic flap can be cut in two or three minutes with ease. The writers have modified the air exhaust of the turbine diverting the air back through a separate tube in the handle, thus the field of operation can be protected from extreme air velocity. This modified turbine has been used successfully in clinical cases, and has many advantages over hand methods in a hospital where the nursing personnel is familiar with its use. Otherwise, sterility of the air cannot be certain and infection is always a possibility.

To deliver speed and power, a special air tank is required to make available neces-

* From the Department of Neurosurgery, the University of Southern California School of Medicine, Los Angeles, California.

sary air pressure of from forty to one hundred twenty pounds, depending on the power and revolutions per minute desired.

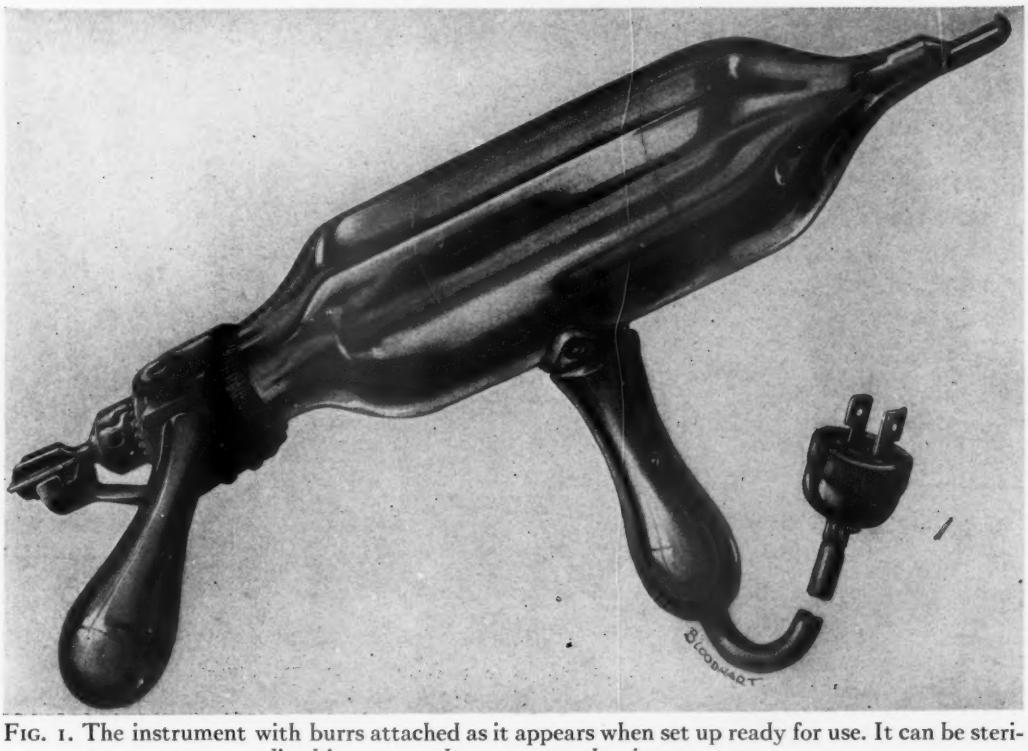

Fig. 1. The instrument with burrs attached as it appears when set up ready for use. It can be sterilized in an autoclave as any other instrument.

A small amount of air under such pressure will leak, even from the modified turbine. Thus it is possible that minute particles of matter may be driven from the pressure tank through the turbine into the field of operation. Since such particles of matter may be contaminated, they are always a possible source of infection unless the containers and air are sterilized and delivered with careful supervision to the turbine.

In the average hospital where the turbine is used only occasionally, sterile air is not conveniently provided. Moreover, the nursing personnel is often unfamiliar with the problem which naturally increases the hazard of infection. This in itself tends to violate the law of asepsis in surgery. With the proper facilities and experience, however, these disadvantages can be adequately overcome. Tanks containing air compressed up to as high as three thousand pounds are available and can be made sterile; this simplifies somewhat the problem of sterilization. Furthermore, pressure-reducing apparatus is available, which makes it possible to deliver promptly the desired air pressure. In general, however, the air turbine is not as simply practical as electric motors of sufficiently equal efficiency in the average hospital.

The electric motor is more practical especially when the surgeon is required to operate in a number of hospitals. Furthermore, it can give a greater range of power at lower speeds as well as high speeds. The efficiency of any power unit depends on its ability to deliver, (1) low speed with power for trephining, and (2) high speed for cutting. In turn the character of the cutting burrs must be such as to be compatible with the speed desired. The electric motor can be made to deliver the necessary power and revolutions per minute for all trephining and cutting purposes. Furthermore, it has simple handling features. (Fig. 1.)* It may be sterilized in an autoclave repeat-

* The motor of the instrument here described has been patterned after a motor designed by Doctor Vernon C. Luck for orthopedic purposes.

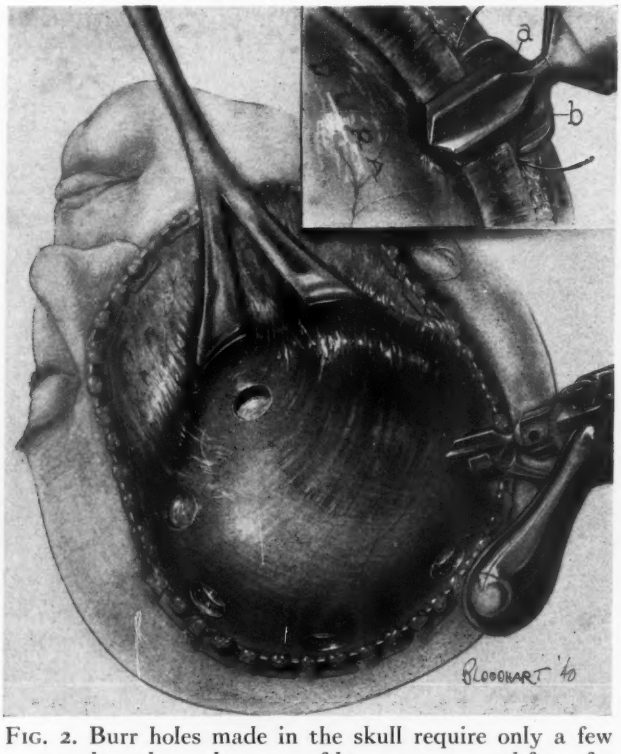

FIG. 2. Burr holes made in the skull require only a few seconds each. *a*, character of burr as patterned for safeguarding the dura; diameter of perforation one-half inch. *b*, adjustable depth gauge safeguarding the burr from going through the opening to an undesirable depth.

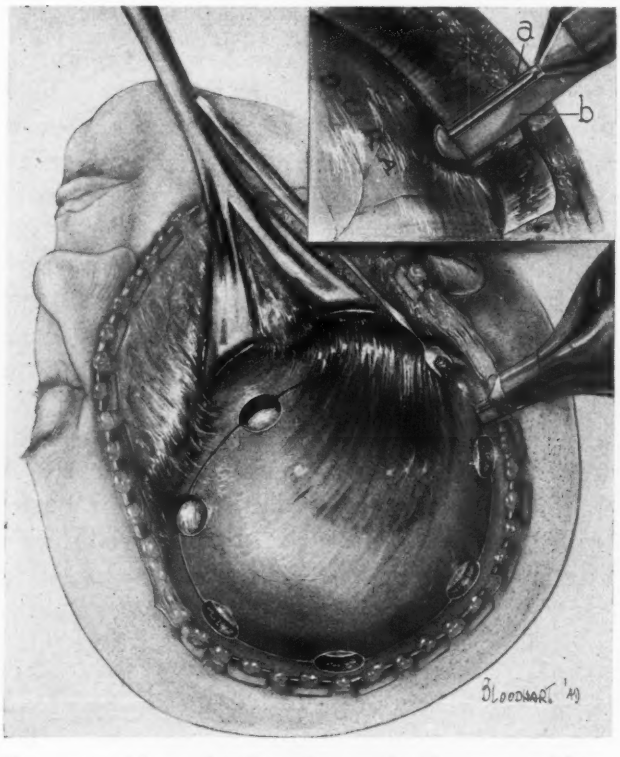

FIG. 3. *a*, side-cutting burr for cutting between perforations. The burr from which this was drawn makes an incision between perforations 2 mm. in diameter. *b*, dural protector.

edly as any other instrument, thus, aspesis can be simply and rigidly maintained.

For making a rapid trephine opening in the skull up to one-half inch in diameter, 5,000 revolutions per minute is the ideal speed required. Higher speeds add very little, while slower speeds naturally lengthen the time. Such speeds, in turn, requires a special type of burr that will cut evenly and smoothly without jumping out of control. This burr can be best described by illustration. (Fig. 2.) Irrigation while drilling is not necessary; it does not facilitate cutting, and heating does not occur. This burr can be adapted to any available surgical power unit which will deliver the necessary revolutions per minute. At 5,000 revolutions per minute a perforation in even a thick skull can ordinarily be made in approximately six seconds.

The dura naturally requires protection with the use of high-speed drills, and providing this protection has best been accomplished by shaping the cutting point of the burr to an obtuse angle. Thus, when the bone perforation has been completed, the character of the point is such that the burr spins on the dura without doing any damage whatever. Actually, the point of the burr can be run at top speed on the skin of the palm of the hand without injurious effects; it merely spins on the surface. To prevent the burr from slipping through the perforation at high speed to an undesirable depth, a quickly adjustable depth gauge has been devised. The most desirable depth is one-eighth of an inch greater than the estimated thickness of the skull; thus, complete perforation is insured, and at the same time, the point of the burr does not extend far enough inward to cause damage. The depth gauge can be adapted to any available surgical motor unit and can be illustrated better than described. (Fig. 2, insert *b*.)

For making bone incisions between perforations, a modification of the side-cutting burr with a protective booth for the dura advocated by Frazier has been employed, utilizing, however, high speed (20,000 revolutions per minute). Above this speed, as in the air turbine, very little cutting effect is gained, while below the cutting effect is proportionately lost. The cutting burr and dural protector are seen in Figure 3. Incisions in the skull as small as 1.5 mm. in width, can be made between perforations rapidly (ordinarily between eight and ten seconds each). This feature is extremely practical, especially when extending the bone incision from the lower perforations to the base of the flap. By the old method of using the usual DeVilbiss rongeur, the task is tedious, difficult and time-consuming; furthermore, considerable hemorrhage often occurs. Conversely then, with the utilization of the bone-cutting principle, these objectionable features can be precluded. Bone cutting in the average osteoplastic flap can be done with ease in two or three minutes' time. Heating of the bone does not occur when making the larger perforations. When cutting between perforations with the small cutting burr the addition of a few drops of saline solution continuously by the assistant will prevent heating. Thus, an osteoplastic flap can be elevated quickly, safely and with ease.

SUMMARY

1. The development of instruments, especially bone-cutting instruments, has been almost static since the laborious and time-consuming hand instruments first came into general use more than a half a century ago.

2. Mechanized tools in other fields have been developed to a high degree of efficiency, and when modified to suit the conditions encountered in neurosurgery, prove equally efficient in labor saving and time consumption; thus, surgical shock is affected favorably.

3. Mechanized instruments heretofore advocated have not been universally accepted because of numerous disadvantages and dangers.

4. Means for overcoming the disadvantages and dangers of mechanized bone-cutting instruments in neurosurgery are described for use with both electric and pneumatic power units.

A NEW APPARATUS FOR MECHANICAL CONTROL OF INTESTINAL FISTULAE*

A PRELIMINARY REPORT

MEYER M. STONE, M.D.
Assistant Adjunct Surgeon, Sydenham Hospital
NEW YORK, NEW YORK

AN intestinal fistula which opens to the skin surface, whether it be from the large or small intestine, is always a distressing situation for both the surgeon and the patient.

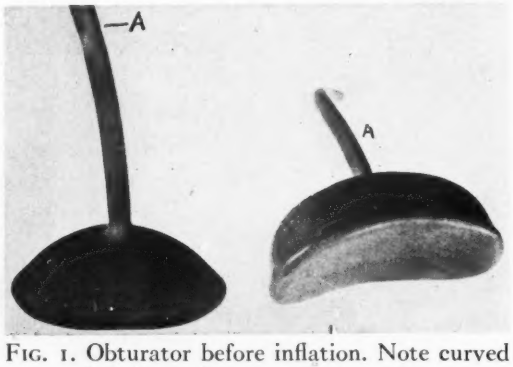

FIG. 1. Obturator before inflation. Note curved inferior surface. A, inflating tube.

Several problems are encountered in the management of fecal fistulae, which require the attention of the surgeon. First and most important is the maintenance of the general health and nutrition of the patient, which suffers materially due to loss of fluids through the fistulous opening. Usually this loss of body fluids is replaced by the intravenous or subcutaneous routes. Second, is the problem of the care of the tissues surrounding the fistulous opening. If suitable ointments or preparations, such as aluminum paste, kaolin, etc., are not used to protect the skin, marked excoriation usually results.

In most cases of fecal fistula there is extended hospitalization and disability. It is my purpose to present an apparatus of original design, which has been successfully used in a case of intestinal fistula to effect the following: (1) To eliminate discharge from the opening and thereby permit retention of normal intestinal juices; (2) to prevent excoriation of the skin; and (3) to re-establish normal evacuation through the rectum. This device is to be used only in cases in which there is no mechanical obstruction distal to the fistula.

The apparatus as shown in the accompanying photograph consists of a soft rubber balloon with a tube A (Fig. 1) to permit inflation. The inferior surface is made of heavier rubber than the rounded superior surface, so that inflation causes the inferior surface to remain flat, while the superior surface bulges, thus preventing obstruction of the bowel.

The balloon is made in one piece; there are no cemented joints. In its deflated state the device is inserted into the lumen of the intestine, through the external opening, with the inflating tube A protruding. About 15 cc. of air are injected into the bag by means of a 20 cc. Luer syringe, and it can now be noted that the superior surface in its bulging, closes the external opening of the fistula and there is no further gross escape of intestinal contents.

By means of a suitable belt shown in Figure 2, the inflating tube, after being clamped to prevent escape of air, is tied under slight tension to the arched metal bridge. Replacement of air, without removal of the bag, is made about every four or five days. The following case demonstrates well the claims made for this device in this preliminary report.

* From the surgical service of Sydenham Hospital, New York City.

CASE REPORT

J. B., a forty year old colored male, was admitted to the ward service of Sydenham Hospital on April 8, 1940. At the time of admission he complained of pain in the right lower quadrant of his abdomen, of thirty-six hours' duration, which was associated with vomiting. There had been no bowel movement or flatus, except for slight return after two enemas.

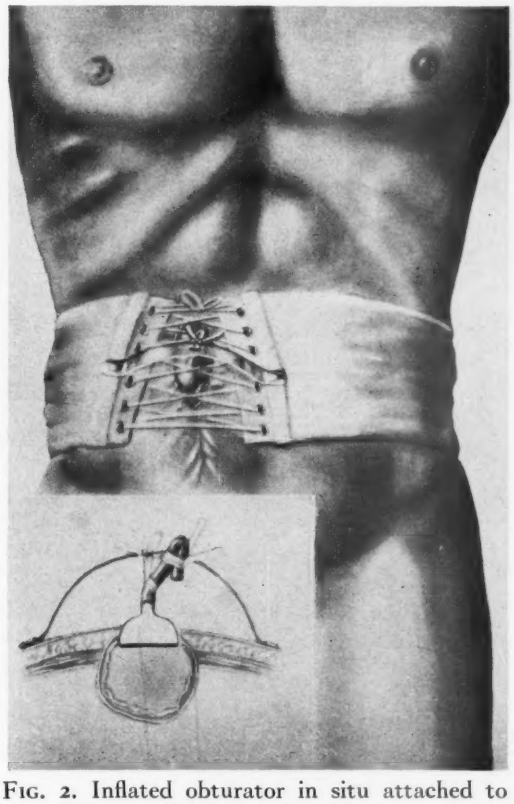

Fig. 2. Inflated obturator in situ attached to arched metal bridge on belt. Cross section of obturator in situ.

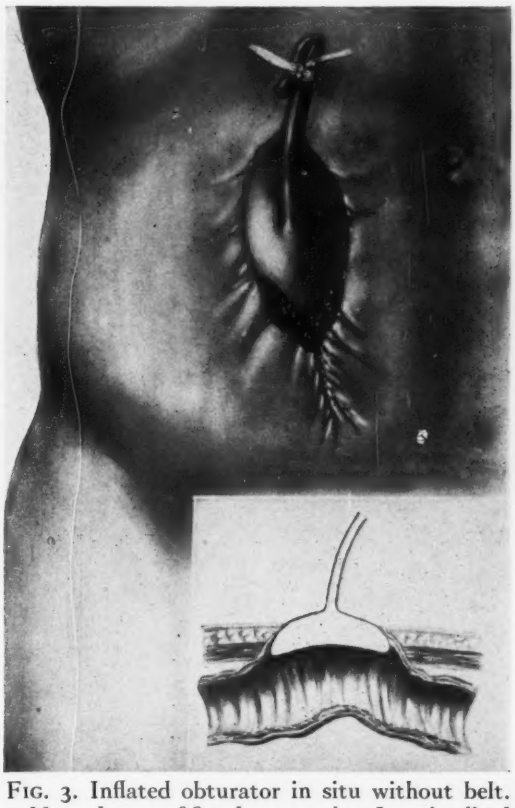

Fig. 3. Inflated obturator in situ without belt. Note closure of fistulous opening. Longitudinal section of obturator in situ.

His previous history was essentially negative, except for the fact that he had received a bullet wound of the abdomen twenty-two years before, at which time the lacerated intestine was repaired.

Physical examination on admission revealed a moderately distended abdomen with marked tenderness in the right lower quadrant. The patient was operated upon the day of admission for intestinal obstruction. The operation consisted of a division of adhesions and an appendicectomy. During the process of separating the adhesions, the bowel was lacerated but immediately sutured.

Laboratory findings: Wassermann test negative (patient was receiving antiluetic treatment); Kahn 1; Kline 1; hemoglobin 72 per cent; red blood cells 4,020,000; calcium 10.4 mg. per cent.

The postoperative course was stormy. About ten days postoperatively, the patient developed an intestinal fistula which discharged fluid and formed feces. During his stay in the hospital, he received several blood transfusions, as well as glucose and saline infusions. The tissues surrounding the fistula showed marked excoriation.

The patient was confined to bed until September. During this time he suffered considerable loss in weight and became dehydrated. The fistula continued to discharge constantly, its size diminishing slightly. The skin healed, and subsequently became excoriated, in spite of various local treatments. Several forms of obturators were employed to seal the fistula with only temporary success. During this entire period, from April until September, the patient had no spontaneous bowel movement or flatus.

On September 9, 1940, our new appliance was inserted into the fistula. On September 12, i.e., three days following insertion, the patient had his first normal spontaneous bowel movement since the operation. The original balloon was

allowed to remain in situ for about four days, at which time it was removed because of defective construction. Another balloon was made and was inserted on October 18, 1940. The following day the patient had two normal bowel movements, though no bowel movement occurred while the balloon was not in situ. The patient was discharged from the hospital on October 20, 1940, with the apparatus in place. His weight was 119½ pounds.

Follow-up observations have been made at frequent intervals during the eleven weeks since his discharge from the hospital. He has had normal bowel movements daily and has gained twenty-seven pounds. He goes about his daily work without inconvenience. His skin is not excoriated, and the lower angle of the wound shows fresh, healthy granulation tissue. His strength has improved remarkably and he has a sense of well-being.

On January 8, 1941, the patient was readmitted to the Sydenham Hospital for closure of the intestinal fistula. Two days after admission, the patient was operated upon under a general anesthetic by Dr. Joseph B. Stenbuck. The intestine was dissected free from its attachment to the skin and subcutaneous tissues, and the opening in the bowel was sutured in three layers. The skin and subcutaneous tissues were sutured. Drains were placed in the upper and lower angles of the wound.

Prior to the use of the apparatus, the lumen of the intestine distal to the fistula barely admitted one finger, due to concentric constriction. At the time of operation, however, the constriction had entirely disappeared and there was present a normal intestinal lumen. Apparently the apparatus over a period of four months had acted as a dilator—an additional extremely useful function.

Following operation the skin edges separated in part, but healing of the subcutaneous tissues and of the intestine took place. The patient had a normal spontaneous bowel movement on the fourth postoperative day. He was discharged from the hospital on January 31, 1941, with a granulating skin wound.

The apparatus used on this patient may be used in any case of intestinal fistula, in order to allow the opening to become smaller prior to operative closure. It is possible that by means of this apparatus, operation may not be necessary, due to spontaneous closure over the apparatus. In any case, the patient's nutrition may be supported because the intestinal juices and food are not lost. This obviates the necessity also of using parenteral fluids and transfusions.

SUMMARY

We have described a device which has successfully controlled the discharge from an intestinal fistula, with the following good results: (1) Re-establishment of normal bowel movements; (2) retention of body fluids; (3) elimination of excoriation of tissues surrounding the fistula; (4) dilatation of constricted intestinal lumen; (5) gain in weight; and (6) decrease in period of disability.

Appreciation is due Dr. Joseph B. Stenbuck for his many helpful suggestions and for his encouragement in this work, and also to Mr. L. T. Hilborn, president of the Clay Adams Company, for his generous co-operation.

A NEW PROCTOSCOPE

CHELSEA EATON, M.D.
Attending Proctologist, Highland and Berkeley Hospitals
OAKLAND, CALIFORNIA

THE usefulness of a proctoscope will be enhanced if its field of visibility is augmented and made accessible for instrumentation. For example, the procedure of fulguration may be facilitated if these advantages are obtained.

Proctoscopes now in use have the common disadvantage of providing only the limited field of exposure which is observed through the distal circular opening of the instrument. Such limitation of exposure imposes a restriction of proctoscopic possibilities. To provide a greater accessible field of visibility a proctoscope has been constructed that is more adaptable than the customary straight tubular type. The same principles which have provided greater exposure for the anoscope have been applied to the proctoscope.[1]

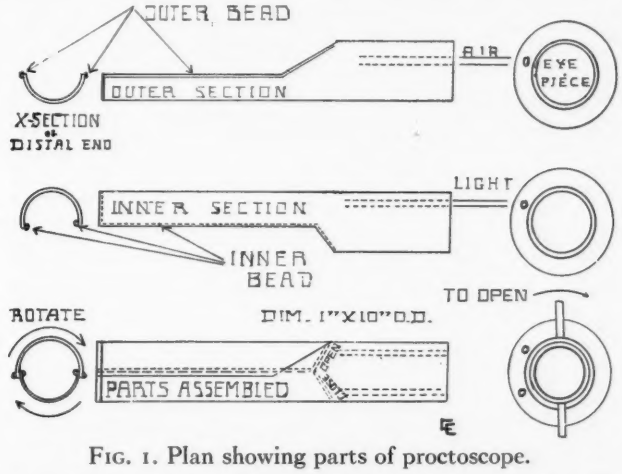

FIG. 1. Plan showing parts of proctoscope.

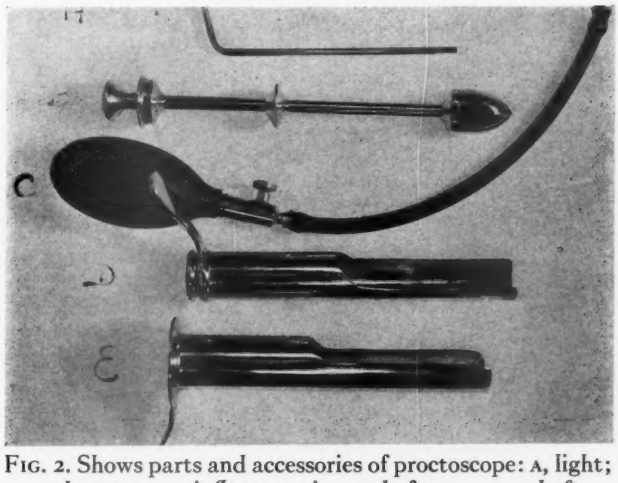

FIG. 2. Shows parts and accessories of proctoscope: A, light; B, obturator; C, inflator; D, inner shaft; E, outer shaft.

By this adaptation a longitudinal area of the bowel wall may be exposed to a distance corresponding to the length of the instrument. Such an exposed area is much larger and more accessible than that obtained by the ordinary proctoscope.

When two partial hemicylinders of tempered steel are adjusted so that the inner cylinder is smoothly encompassed by the

outer one, a variable degree of lateral exposure is obtained by rotation of the instrumental parts. When these semicylindrical shafts are assembled so that a hollow tube is formed, the instrument may be inserted, with an obturator, as an ordinary proctoscope. Once inserted, rotation of the inner shaft will provide exposure of the lateral bowel wall for an extent of 180 degrees. Rounded metal strips of beading on the edges and angles of the hemicylinders prevent injury to the bowel during instrumentation. Inspection of the mucosa is facilitated by a movable light carrier, an air inflator and a magnifying lens for the eye piece.

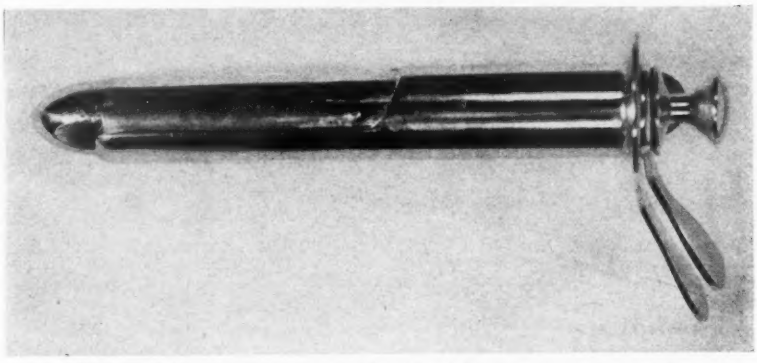

Fig. 3. Shows proctoscope closed with obturator inserted.

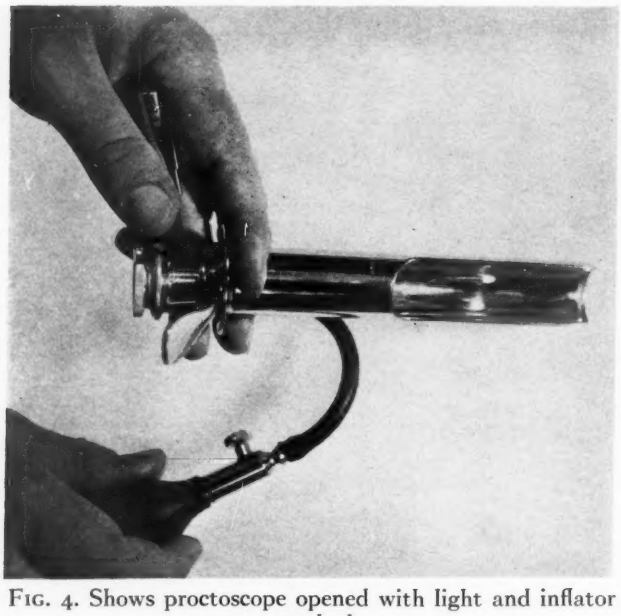

Fig. 4. Shows proctoscope opened with light and inflator attached.

SUMMARY

A new proctoscope is described which provides wide exposure.

REFERENCE

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AN INTRA-ABDOMINAL RUBBER RETRACTOR

OREN ELLINGSON, M.D.
BROOKLYN, NEW YORK

IT has long been recognized that gauze employed in the abdomen often is traumatic, readily evidenced by the mechanical peritonitis occurring when gauze has been used during a long laparotomy. Moreover, it is unwieldy and frequently must be used in large quantities to accomplish its purpose. Rubber, on the other hand, is nontraumatic, may be used for long periods of time, withstands sterilization well, but is nonabsorbent.

Most of the rubber devices in use are either in the form of thin rubber sheets of various sizes or rubber envelopes into which gauze or stays can be inserted to produce the desired rigidity. They are bulky and present few features making them superior to gauze.

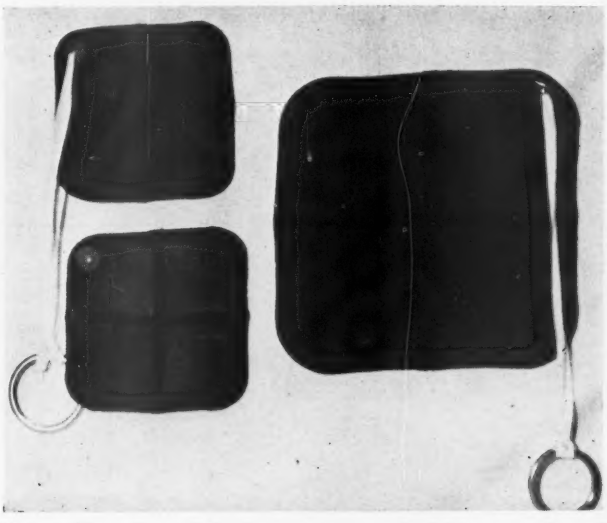


FIG. 1. Two sizes of the laparotomy pad with tape and steel ring attached.

FIG. 2. Method of introduction of pad into the abdomen.

We describe a new laparotomy pad which may be used wherever gauze is used in the abdomen, and it also presents the features of an intra-abdominal retractor. It is constructed of a square latex rubber sheet into the edges of which has been sealed a fine steel spring coil. It is marketed in two standard sizes four and three-fourths

inches by four and three-fourths inches and eight inches by eight inches, but may be made in any form. The larger sizes contain additional coils in the center for increased strength. At one corner of each pad an eyelet is placed through which a cloth tape may be threaded if desired. It is possible to fold or roll these pads into any desired shape, and upon release they will assume their normal character. They possess sufficient rigidity to dam back the intestines, but are not capable of traumatizing the viscera. They may be repeatedly sterilized by boiling, do not lose their form even after long usage, can be patched if torn and are easily introduced and removed from the abdomen.

In use, the pad rolled into the form of a tube or folded upon itself is introduced through the abdominal incision, and with the viscera displaced, springs open thus daming the intestines from the desired operative field. A flat ribbon retractor may be placed against the pad if further retraction is desired. The large pad is useful principally in pelvic work, while the smaller one may be used throughout the abdomen.

Fig. 3. The pad unfolds in this manner when in place in the abdomen.

The small pad is especially applicable to gallbladder surgery.

Another feature of this pad is its utilization as a retractor of omentum and intestines during closure. It is placed beneath the peritoneum with the tape protruding from one angle of the wound. Thus the peritoneum may be closed without fear of involving the viscera in the suture to within two to three inches of one angle, when the pad may be removed.

A contraindication to the use of this device is adhesions. These must be separated before introduction of the pad.

This pad has been designed to make available a rubber device to replace gauze in the abdomen wherever possible, and offer the added feature of an intra-abdominal retractor. It is in use at the Long Island College, Greenpoint and Methodist Hospitals in Brooklyn, New York.

Bookshelf Browsing

THE HISTORY OF HEMORRHOIDS*

HAROLD LAUFMAN, M.D.
Clinical Assistant in Surgery, Northwestern University and Michael Reese Hospital
CHICAGO, ILLINOIS

BECAUSE of their prosaic and widespread incidence throughout the ages, hemorrhoids have played a highly important rôle in the history of medicine, as well as in the development of civilization.

The loss of blood has always been an intriguing phenomenon, attracting the attention of medical men ever since the beginning of the history of medicine. The word, "hemorrhoids," is derived from the Greek, and means "the flow of blood."[1] Hippocrates applied this name to the flow of blood from the veins of the anus, but subsequent writers used the term synonymously with hemorrhage. Thus, Aristotle described hemorrhoids of the mouth, and Cornelius Celsus, Aetius of Amida, Paul of Aegina and later surgeons of the Byzantine period described hemorrhoids of the various organs such as the uterus and bladder.

ETIOLOGY AND PATHOGENESIS

Before Hippocrates' time, (5th Century B.C.) any disease in or around the anus was called hemorrhoids. Hippocrates considered hemorrhoids a favorable disease, and often even a useful one. He attributed the phenomenon of "flowing" to a general purification of the organism.[2] This hemorrhoidal flow, formed, "by the reunion of all the wastes of the organism, is made up mainly of blood of the spleen and of the bile, which is drawn out, that is to say out of the spleen, and escapes through the hemorrhoids as from the rectum.

"The disease of hemorrhoids," he wrote, "is formed in this way: if bile or phlegm be determined to the veins in the rectum, it heats the blood in the veins; and these veins becoming heated, attract blood from the nearest veins, and being gorged, the inside of the gut swells outwardly, and the heads of the veins are raised up, and being at the same time bruised by the faeces passing out, and injured by the blood collected in them, they squirt out blood, most frequently along with the faeces, but sometimes without faeces."

Hippocrates also believed that hemorrhoids prevented other diseases. "Those who have hemorrhoids," he writes, "are not subject to pleurisy nor to pimples, nor to boils, nor perhaps to leprosy. It is a fact that of those who have been completely cured (of hemorrhoids), several have been quickly afflicted with one of these diseases fatally." This principle is discussed under the title, "Metastasis," in Hippocrates' writings. In other places he draws attention to the relationship existing between hemorrhoids and diseases of the liver, and he mentions that ascites is a consequence of hemorrhoids.

Galen (2nd Century A.D.) sets forth a similar conception in the fourth book of the "Epidemics,"[3] and Celsus (about 25 B.C. to about 40 A.D.) held a similar point of view.

These ideas held until the seventeenth century, when Morgagni[4] observed that

* From the Departments of Surgery of Northwestern University Medical School and Michael Reese Hospital, Chicago, Illinois.

hemorrhoids did not exist in animals, and therefore attributed them to the erect position of man and to a hereditary predisposition.

Georg Ernst Stahl (1660–1734), a German physician and chemist of the seventeenth century, did much to influence the ideas of the causation of hemorrhoids.[5] He was a professor of medicine at Halle and physician to the King of Prussia, and his high position commanded respect for his theories. According to Stahl and his school, hemorrhoids become venous reservoirs, destined to collect, in order to reject them later, all the wastes of the body. In other words, the flow of blood from hemorrhoids was considered a "vital act" due to a plethora and not a disease, per se, i.e., the equivalent of menstrual flow.

The difference between Stahl's theories and those of the ancients is that he did not believe as Hippocrates did, that the blood given off by hemorrhoids was splenic in origin; Stahl believed that the blood flowed into the hemorrhoidal veins because of an overflow. If the flow were stopped, all chronic diseases and particularly mental disorders would follow.

Many subsequent writers attributed hemorrhoids to defective circulation in the anorectal region, thus opposing Stahl's plethora theory with one of mechanical stoppage.[1] This theory is first mentioned in the Dictionary of James (1760), attracting attention to the difficulty which the blood encounters in circulating from the hemorrhoidal veins to the portal vein and the liver because "the veins are vertical and possess no valves." These circulatory troubles are due "to the presence of acrid and caustic matters which frequently cause spasms, making the circulation of blood irregular." This conception has persisted to the present day. Some modern authors attribute pruritis ani and peri-anal rash to the action of toxins which are stagnant products in the hemorrhoidal veins.

In the eighteenth century, constitutional diatheses and temperaments attracted the attention of the physicians, and therefore took their place in the description of this affliction. Montegne illustrated this trend with his famous portrait of a man with hemorrhoids: "The man with hemorrhoids is large, thin rather than fat, yellow of coloring has large veins winding up the arms and on the hands, legs and feet. He has black hair, a dark fire animates his look; he is brusque, high strung, his passions are violent, his resolutions firm; he is a heavy eater, but is indifferent to the choice of food. He is often tormented by gas, and almost always constipated."

Quenu, in the nineteenth century, introduced the idea of inflammation into the pathogenesis of hemorrhoids.

Summing up the theories of the causation of hemorrhoids, as they evolved through the ages, we find the following periods:

1. *The pre-Hippocratic period* in which all infections of the anal region are called hemorrhoids; this confusion which is carried by some writers to the middle ages, makes interpretations of the descriptions of ancient writings very difficult.

2. *The period of Hippocrates and his school,* which localizes hemorrhoids to the rectal veins, but attributes to them the rôle of beneficial expulsion of blood.

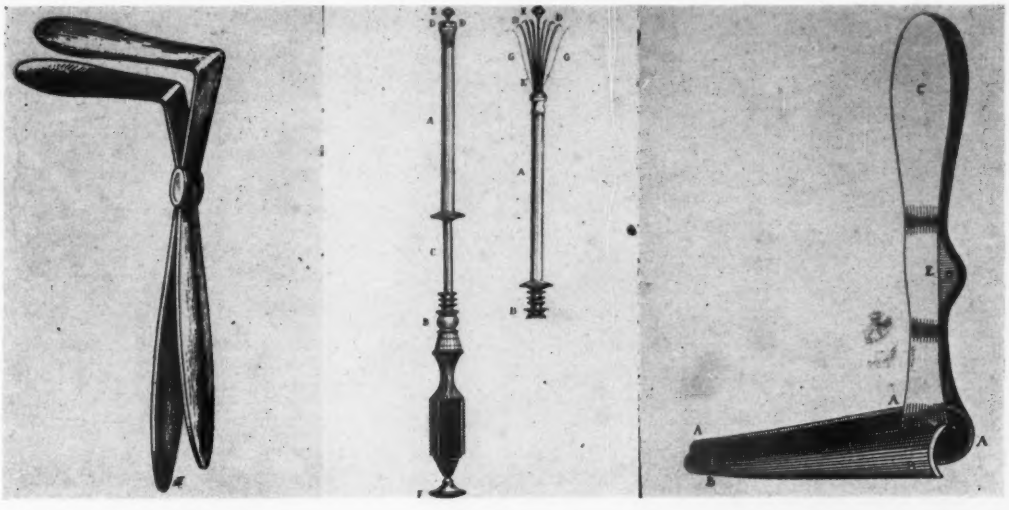
3. *The period of Stahl and his coherents* who consider hemorrhoids as an indication of a surplus of blood. The hemorrhoidal veins are intended to receive and eliminate waste products, thereby having a function analogous to that of menstrual flow.

4. *The post-Stahlian period,* during which the theories of constitutional, nervous, mechanical, and infectious causes are formulated and developed; many of these theories are still in use today.

HISTORY OF THE TREATMENT OF HEMORRHOIDS

The diversity of conceptions of the nature of hemorrhoids naturally influenced the modes of treatment. We, therefore, find a wide divergence in treatments, commensurate with the prevalent ideas of hemorrhoids at a given time in history. The

ancients disagreed radically as to whether hemorrhoidal flow should be stopped, diminished or augmented.



A B C

FIG. 1. A, anal speculum in bronze, found in the ruins of Pompeii. B, diverging crochet hooks of Chaussaignac, used to bring forth hemorrhoids by inserting the instrument closed, and withdrawing it with the hooks diverging. C, anal speculum illustrated in the Dictionary of James (1760). (Bensaude, R. *Presse méd.*, 45: 1391, 1937.)

In this regard, Hippocrates contradicts himself. In one passage of his writings, he advises against the suppression of hemorrhoids while in others he recommends the destruction of all the clusters. The following passage has been translated from Hippocrates writings by Adams:[2]

The disease of hemorrhoids "is to be cured thus: In the first place it should be known in what sort of a place they are formed. For cutting, excising, sewing, binding, applying putrefacient means to the anus,—all these appear to be very formidable things, and yet, after all, they are not attended with mischief. I recommend seven or eight small pieces of iron to be prepared, a fathom in size, in thickness like a thick specillum, and bent at the extremity, and a broad piece should be on the extremity, like a small obolus. Having on the preceding day first purged the man with medicine, on the day of the operation apply the cautery. Having laid him on his back, and placed a pillow below the breech, force out the anus as much as possible with the fingers and make the irons red-hot, and burn the pile until it be dried up, and so as that no part may be left behind. And burn so as to leave none of the hemorrhoids unburnt, for you should burn them all up."

(This is contrary to previous advice given at Aph. VI, 12, in which he advised leaving one hemorrhoid, as a safety valve, so to speak, to the system. Celsus and Paulus Aegina followed this rule in their ligation operations, not mentioning cautery. Aetius, however, followed the principle of removing all the clusters.)

Hippocrates recommended a paste made with urine to be applied for hemostasis after operation.

The treatment of hemorrhoids by cautery has been a controversial issue since ancient times. Although it was recommended by Hippocrates and Albucasis, it is not described by Celsus or Paulus and is condemned by Audreas and Cruce. Dupuytren and Paré did not agree with the principle of cautery. Sir Charles Bell, the famous eighteenth century English surgeon said, "smoke rising from the anus under the influence of a hot iron should impress the friends of the patient and bring back their minds to the days of the Inquisition." To this day surgeons are divided in their approval of cautery in the treatment of hemorrhoids.

Galen employed bleeding from the arm to stop the flow from hemorrhoids and bleeding from the feet to bring it back.

The old books are filled with medical prescriptions, some of the most interesting of which are those of John Arderne[6] (1412):

Fig. 2. A, operation for hemorrhoids done by Aetius. The surgeon has pulled down the hemorrhoids with a hook and has cut them in a circular manner with a large blade. B, from the same period, showing the surgeon exerting finger compression to the anus after excising the hemorrhoids. Notice the spurt of blood falling into the cup. (Bensaude, R. *Presse méd.*, 45: 1391, 1937.)

Suction cups were applied to incisions on the thighs to prevent hemorrhoidal flow by Galen, Oribasius and Antyllus. They also recommended careful irrigation of the place of application with hot water at the same time.

Another method which Galen used to stop the flow of hemorrhoids was to apply tourniquets around the hands and arms, while he warned that tourniquets around the thighs would have a different effect and should not be employed except in hemorrhages of the upper portions of the body.

Celsus recommended that in some cases the flow of blood from hemorrhoids should not be suppressed for fear that the inspissated, infected blood would be carried to the heart and viscera.

Ambroise Paré (1545) made the following recommendations: "If they (the hemorrhoids) flow moderately and the patient withstands elimination without discomfort they must not be stopped at all because it will aid him in avoiding mental depression, mania, leprosy, congestion of the bladder and other affectations such as pleurisy and malignant ulcers, but if the flow of blood is diminished one should stop it for otherwise it causes hydrops by the cooling of the liver with the resultant weakening of the entire body."

"Against bleeding piles: moisten the finest wheat flour with the juice of millfoil and make it into pills. Give three or four daily. And the phlebotomy should be performed from the basilic vein of the arm on account of the previous materis morbi, and afterwards from the saphenous vein at the outer ankle. The tibial saphenous diverts the hemorrhoid flux and permanently restrains the piles.

"Against inflamed piles: Wash the part in the juice of parsley and salt. . . . Powdered hare burnt stops the bleeding from piles better then anything."

The great number of remedies in vogue inspired Ravaton, in 1776, to write: "Everyone uses special remedies for hemorrhoids, because those that have been recommended by the great masters of the Art have worked out very poorly."

The Dictionary of James (1760) suggests a conservative method of therapy, consisting of a moderate and exacting régime: "One should avoid carefully the remedies that are warm, and restrain the use of myrrh, saraphen and all elements of the same quality; avoid wine, debauchery, bad temper, violent exercises, immoderate use of women, and do not ride horseback."

The truly surgical period in the treatment of hemorrhoids starts in the nine-

teenth century with the work of Kerby (1818), Brodie (1835), Smith (1835), and Salmon (1835) in England and America, and of Boyer (1830), Chassaignac (1858), and Benoit in France. Yet the surgical processes used are essentially those that have been known since earliest antiquity.

Fig. 3. German woodcut of the fifteenth century showing a country innkeeper retracting one buttock with his hand, showing his affliction to the surgeon. The peripatetic surgeon treats his patient while his horse waits. The man of the art with glasses and lantern holds the pincher with which he will crush or cauterize the hemorrhoids.

Excision alone was practiced by Hippocrates, Galen, Celsus, Aetius, Albucasis, Rhazes and others.

The ligature operation was done by Galen, who recommended the use of a strong flax thread made to traverse the base of the tumor by means of a needle. The ligature was then tied on each side and the tumor permitted to slough off.[7] In 1813, this procedure was quite popular with French surgeons; but later, owing to some accidents, it lost its popularity. However, Miles and others do essentially the same procedure today. Amputation of the tumor after ligation of its base was popularized by Salmon, and is the procedure of choice at the St. Mark's Hospital, London, to the present day.

Instruments used in operations for hemorrhoids have been as strange as they have been numerous. In Scultetus' Armamentarium Chirurgicum[8] (1656) are descriptive illustrations of some of the instruments used at that time. Among them are metal rings for dilating the anus, and an instrument for delivering hemorrhoids, consisting of chains with hooks on one end, and attached into a handle at the opposite end for traction. Another method was to put a stout cord through the base of the hemorrhoid by means of a heavy needle. Using this for traction, the hemorrhoids were burnt off with cautery. One of the most interesting methods of curing hemorrhoids was the lineal crushing of hemorrhoidal clusters as practiced by Chassaignac. This surgeon began by bringing out the hemorrhoidal clusters with an instrument consisting of diverging and multiple branches, sort of an upside down umbrella, which is introduced into the rectum closed, and which is pulled out after it has been opened, thus bringing forth the hemorrhoids. (Fig. 1B.)

The exact origin of the injection treatment of hemorrhoids is not known although it is said that one Mitchell of Clinton, Illinois, originated this form of treatment in 1870. However, it is generally known that it was first practiced by charlatans, known as "healers of hemorrhoids," both in England and the United States. Although this method at

first was looked upon with disdain by the physicians of the medical art, it finally attracted the attention of some of them and a few English surgeons began to practice it about 1871. It was not commonly accepted until Dudley Wright published his treatise on the subject near the turn of the twentieth century.

ECCLESIASTICAL WRITINGS AND FOLKLORE

It is said that there were doctors who specialized in the treatment of hemorrhoids in Egypt before Joseph was sold as a slave. The word, "hemorrhoid," was mentioned in many passages of ancient Hebrew literature.[9] In the bible, the term, "emerod," was used. In Deuteronomy, the Fifth Book of Moses of the Old Testament, one finds the following phrase: (Chap. xxvii, paragraph 27) "And the Lord will smite thee with the botch of Egypt and with the emerods and with the itch whereof thou canst not be healed."

Three centuries later the Philistines, who captured the sacred ark were striken with hemorrhoids, according to the first Book of Samuel. The Philistines called the priest and divine men and asked them what to offer with the Ark of Jahweh. (Samuel i, Chap. vi, paragraph 4). "Then said they, what shall be the offering which we shall return to him? (The God of Israel). They answered, 'Five golden emerods, and five golden mice, according to the number of the lords of the Philistines: for one plague was on you all, and on your lords.'"

There has been much controversy over the translation of these passages. Church[10] is convinced that the term emerod implies a venereal disease. Neustatter[11] on the other hand, offers a logical argument indicating that the scourge was not syphilitic, but does not state that the word actually means hemorrhoids. He cites several writers who interpreted emerods as implying syphilis, including Trapp (1662) who said it was "lues venerea," Hensler (1783), Friedrech (1848), and Haeser, who called emerods "condylomata at anum." J. F. Von Meyer in his amendment of Luther's version, renders it as "feigwarzen," as does the Berlenburger Bibel. Jutting's Biblisches Worterbuch defines feigwarzen as (syphilitic) ulcers or boils, like figs, or hemorrhoidal tumors.

Galen wrote that the "Stone of India worn around the neck will stop the hemorrhoidal flow." For the same purpose, placing an emerald in the navel had been advocated. Another method was carrying between the shoulders the roots of a Century plant. Men chose black, women, white ones.

In the middle ages it is interesting to note that the term, "hemorrhoids," is almost completely lost. This is perhaps due to the fact that it was one of the words which the decency of language forbade. During this era the affliction was called "the illness of St. Fiacre," thus becoming a respectable illness.

In France, chestnuts were considered a good remedy. It seems as though the French attributed good results to chestnuts because of their resemblance to hemorrhoids. It is interesting to follow the influence of chestnuts in the treatment of hemorrhoids into the nineteenth century, when Artault recommended the tincture of chestnuts as an internal treatment.

It had also been recommended that the back leg of a toad or an entire dried toad, be worn around the neck or under the arm pits as a preventive measure against hemorrhage from the veins. Among other methods of treatment we find various erotic practices involving the use of animals. These processes were still in use in France as late as the middle of the nineteenth century.

In many artistic works, as well as in the letters of famous men of history, numerous allusions are made to hemorrhoids. For example, few of us realize when we listen to Goethe's "Faust," that the editor, Nicolai, is referred to as a "Proctophantasmist." One of Mephistopholes' lines, during the Walpurgis night reads: "He now will seat him in the nearest puddle; The solace

this, whereof he's most assured: And when upon his rump the leeches hang and fuddle, He'll be of spirits and of Spirit cured."

Don Juan, of Austria, who won the battle of Lepante (1571), died at Namur, of a hemorrhage four hours after an incision made for a large cluster of hemorrhoids.

Martin Luther, the great reformer, suffered from prolapsed hemorrhoids, and described his illness at great length in a letter to Justin Jones written in 1528.

According to Heinrich Heine, the poet, Meyerbeer was stricken with hemorrhoids, and Heine is even said to have written poetry about the "hemorrhoidal music" of the great composer.

SUMMARY

The methods of treating hemorrhoids have been remarkably similar in principle throughout the history of medicine. The surgical procedures employed by Hippocrates included the ligature operation, excision and cautery. These procedures have been carried through the ages with only minor alterations or variations but are the basis for all operations for hemorrhoids in use today.

The fact that hemorrhoids are frequently mentioned in historical writings emphasizes the influence this affliction has had upon man throughout the ages.

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Selected Book Reviews

VACATION READING

AT this time of the year the average physician becomes a bit stale mentally. He has little or no taste for textbooks or weighty tomes; his thoughts wander to other things. But whether on vacation or doing merely routine work he, by force of habit, picks up a book at the close of the day and reads. Some prefer a detective story, others a novel and still others a book on the war. We are offering a few books by physicians which we found interesting. Each in its own way is far above the average and each gave us no end of pleasure. Thus, we recommend these books without reservation.

MAGIC IN A BOTTLE*

By Milton Silverman, ph.d.

MAGIC in a Bottle, by Milton Silverman, gave us more pleasure than one would think possible from the title. The various members of our family also found it a "swell book." It contains the true stories of ten wonder-working drugs and of the men who, wittingly or unwittingly, discovered them. We learn the full story of Sertuerner and morphine, Pelletier and quinine, Withering and digitalis, Koller and cocaine, Lister to Ehrlich to 205, Kolbe and aspirin, Fischer, von Mering and the barbitals, Eijkman and the vitamins, Brown-Sequard and the hormones, and Domagk and sulfanilamide. This may not sound exciting, but we assure you that the stepping stones to the final chapter concerning these drugs—the chief drugs in modern practice—and the human beings behind them make both fascinating and interesting reading. Physicians, as a whole, know very little about medical discoveries and the events leading up to them. Therefore, while this book will entertain, it will also prove a fountain of facts. Our hope is that thousands of

* New York, 1941. The Macmillan Company.

physicians will get this book, for we are certain they will enjoy it as much as we did.

THE DOCTOR TAKES A HOLIDAY . . . AN AUTOBIOGRAPHICAL FRAGMENT*

By Mary McKibbin-Harper, M.D.

THE Doctor Takes a Holiday is worthy of a high mark. Dr. McKibbin-Harper has published several charming sketches of her travels in the Far East: The Doctor Looks at Turkey, Greece, Scandinavia, etc. Her readers will welcome this new volume.

In order to give a short résumé of what the book is about we quote from the Foreword: "The book, essentially one of travel in the Orient, is sociological in its scope, describing native customs, religions and supersititions and it is an eye-opener as to native medical customs and the beneficent influences of education and modern health service. It tells of men and women doctors and other interesting people met in a round-the-world tour while amusing experiences are cleverly illustrated by many pen drawings of Kathryn Yager Lewis." The Doctor Takes a Holiday is an interesting, readable and authentic travel book of a new kind.

TEST TUBES AND DRAGON SCALES†

By George C. Basil, M.D.

In Collaboration with Elizabeth Foreman Lewis

A PATIENT gave us Test Tubes and Dragon Scales, by George C. Basil, M.D., formerly superintendent of the "Syracuse-in-China" Hospital, Chungking, and we threw it aside, inwardly wondering why people make presents of books to one who gets more books for review than he can read. One cold, snowy night we chanced to pick it up. Casually, we began reading it, and read it from cover to cover in two installments. We learned all about an American physician in China and his trials, tribulations and adventures. The book is different, superbly written, provides full enjoyment and at the end leaves one satisfied. Your wife, daughter and sister will also enjoy it.

* Grand Rapids, Iowa, 1941. The Torch Press.

† Philadelphia, 1940. The John C. Winston Company.

A DOCTOR'S HOLIDAY IN IRAN*

By Rosalie Slaughter Morton, M.D.

A DOCTOR'S Holiday in Iran, by Rosalie Slaughter Morton, the author of "A Woman Surgeon," is particularly timely and interesting in view of the present world conflict. Although one can take it as easy, light reading, it is, after all, a valuable contribution to the bibliography of Iran. "The home of the Peacock Throne has always been, at least to the American public, the land of romance and mystery—the home of poets singing in Persian gardens to the accompaniment of bulbul birds and tinkling fountains . . . We are fortunate in that that old-new Iran is here interpreted to us by a physician who has both unusual ability to observe and the judgment to evaluate such observations in the light of acquired knowledge and experience," wrote Hugh S. Cumming, Surgeon-General of the U. S. A. (retired) who did the Foreword. The book is illustrated and is decidedly worth while.

* New York, 1940. Funk and Wagnalls Company.

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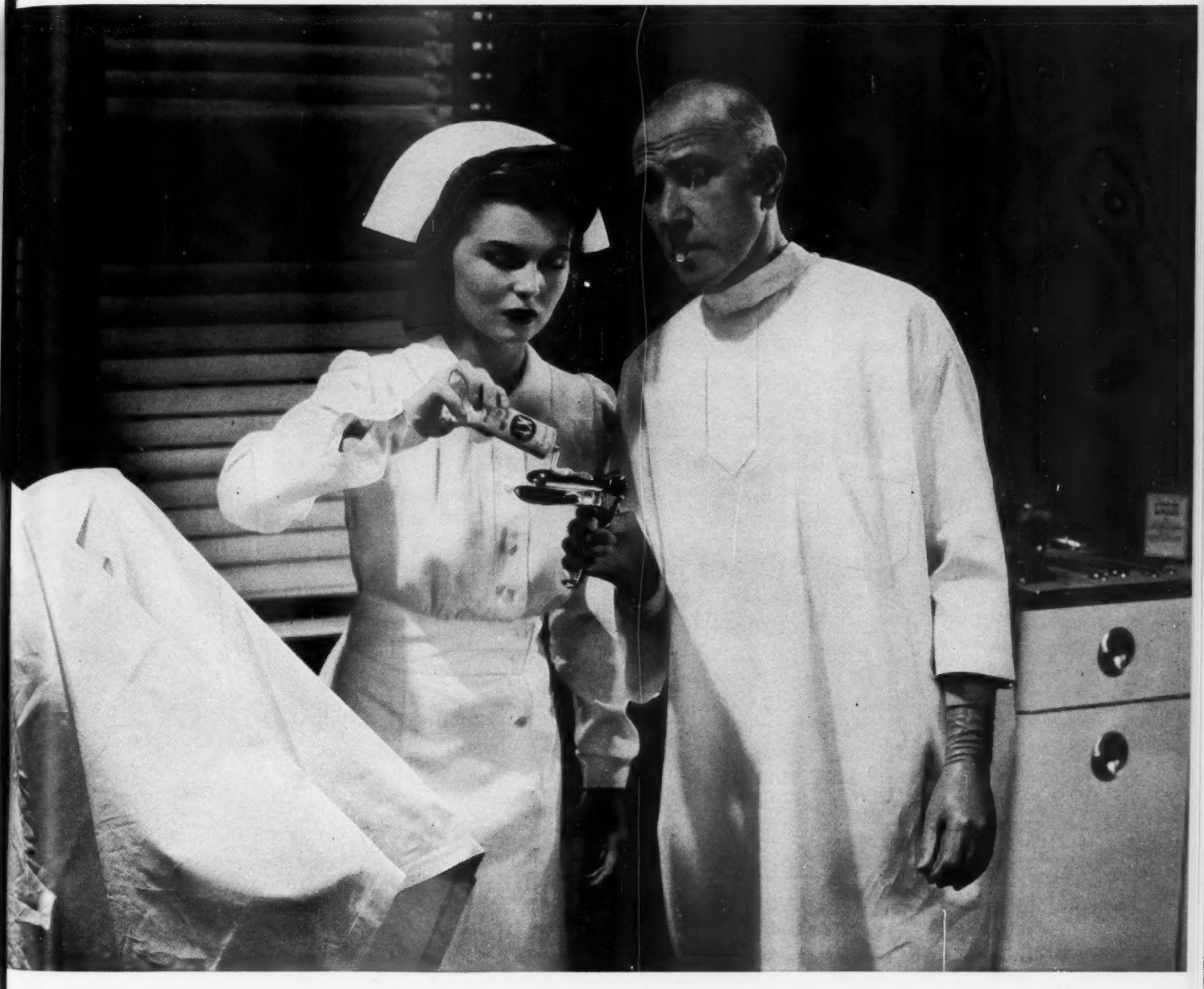

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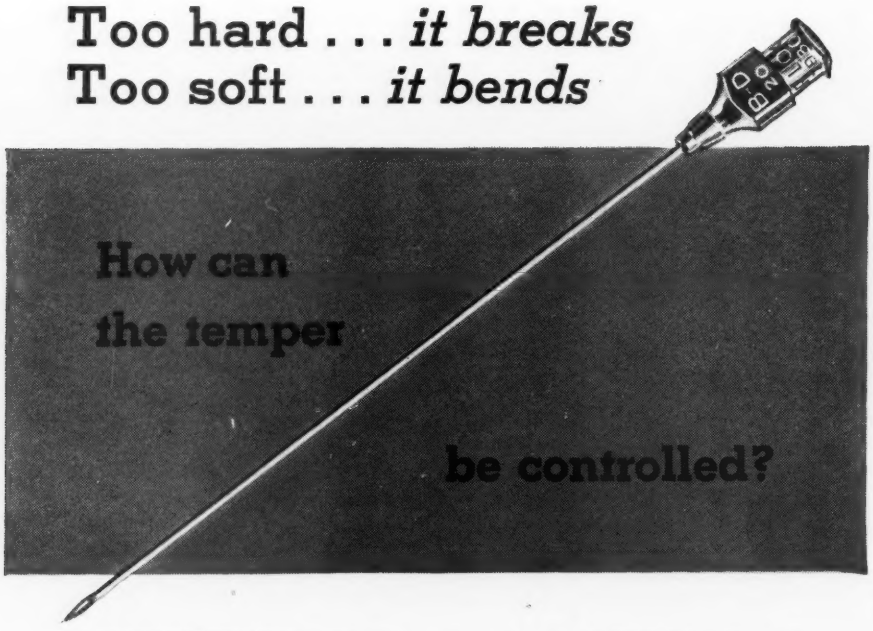

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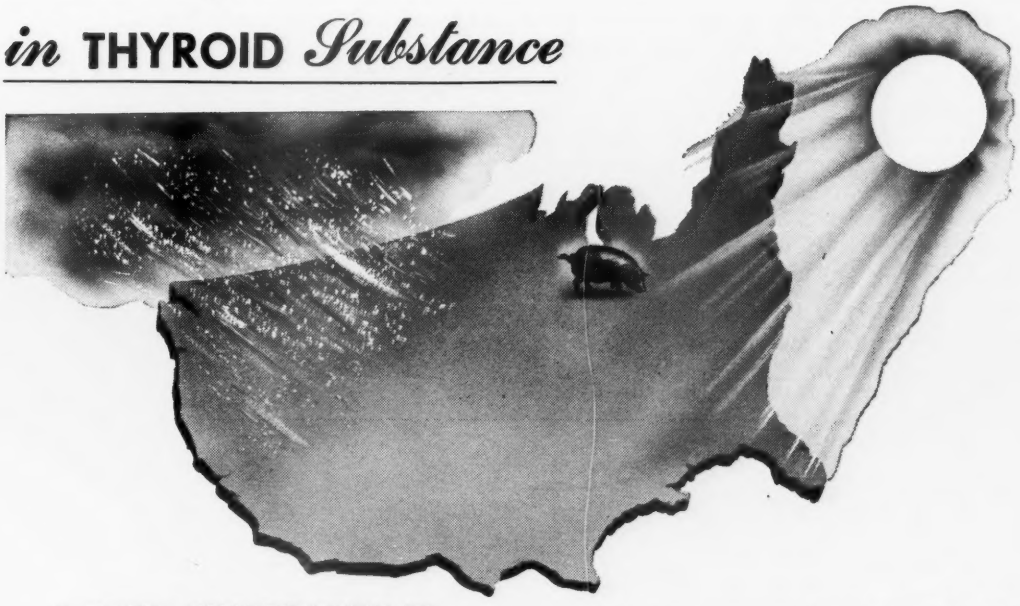
The Regional and Seasonal Variation in THYROID *Substance*



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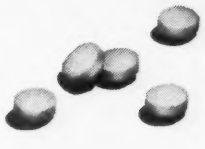

Society Meetings

AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS

New Orleans, January 12–16, 1941. (Secretary—DR. CARL BADGLEY, University Hospital, Ann Arbor, Mich.)

AMERICAN ASSOCIATION FOR THE STUDY OF GOITER

Boston, May 12–14, 1941. (Secretary—DR. W. BLAIR MOSSER, Kane, Penna.)

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Seigniory Club, Montreal, Que., May 29–31, 1941. (Secretary—DR. RALPH G. CAROTHERS, 409 Broadway, Cincinnati)

AMERICAN ASSOCIATION OF GENITO-URINARY SURGEONS

Hot Springs, Va., May 29–31, 1941. (Secretary—DR. CHARLES C. HIGGINS, 2020 East 93rd Street, Cleveland)

AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS

Pittsburgh, May 5–9, 1941. (Secretary—MR. ARMOUR G. PARK, 540 N. Michigan Ave., Chicago)

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Hot Springs, Va., September 11–13, 1941. (Secretary—DR. JAMES R. BLOSS, 418—11th St., Huntington, W. Va.)

AMERICAN ASSOCIATION OF RAILWAY SURGEONS

Chicago, September 8–10, 1941. (Secretary—DR. R. B. KEPNER, 547 W. Jackson Blvd., Chicago)

AMERICAN COLLEGE OF SURGEONS

Boston, November 3–7, 1941. (Secretary—DR. FREDERIC A. BESLEY, 215 N. Sheridan Rd., Waukegan, Ill.)

AMERICAN CONGRESS OF PHYSICAL THERAPY

Washington, D. C., September 1–5, 1941. (Secretary—DR. RICHARD KOVACS, 2 East 88th Street, New York)

AMERICAN GYNECOLOGICAL SOCIETY

Colorado Springs, May 26–28, 1941. (Secretary—DR. RICHARD W. TELINDE, Johns Hopkins Hospital, Baltimore)

AMERICAN MEDICAL ASSOCIATION

Cleveland, June 2–6, 1941. (Secretary—DR. OLIN WEST, 535 N. Dearborn Street, Chicago)

AMERICAN ORTHOPAEDIC ASSOCIATION

Toronto, Can. June 9–12, 1941. (Secretary—DR. C. W. PEABODY, 474 Fisher Bldg., Detroit)

AMERICAN PROCTOLOGIC SOCIETY

Cleveland, June 1–3, 1941. (Secretary—DR. W. H. DANIEL 1930 Wilshire Blvd., Los Angeles)

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New York, April 10, 1941. (Secretary—DR. PAUL M. WOOD, 745 Fifth Avenue, New York)

AMERICAN SURGICAL ASSOCIATION

White Sulphur Springs, W. Va., April 28–30, 1941. (Secretary—DR. CHARLES G. MIXTER, 319 Longwood Avenue, Boston)

ASSOCIATION OF MILITARY SURGEONS OF THE U. S.

Louisville, Ky., October 29–November 1, 1941 (Secretary—COL. JAMES M. PHALEN, 1870 Wyoming Ave., N.W., Washington, D. C.)

CONGRESS OF ANESTHETISTS

Boston, November 3–7, 1941. (Secretary—DR. E. KLAUS, 1699 W. 25th Street, Cleveland)

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Mexico City, August 10–14, 1941. (Secretary—DR. CHARLES H. ARNOLD, 903–15 Terminal Bldg., Lincoln, Nebr.)

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NEW ENGLAND SURGICAL SOCIETY

Hanover, N. H., September 5–6, 1941. (Secretary—DR. JOHN F. GILE, Hanover, New Hampshire)

PACIFIC COAST SOCIETY OF OBSTETRICS AND GYNECOLOGY

Pasadena, Cal., November 5–8, 1941. (Secretary—DR. W. B. THOMPSON, 6253 Hollywood Blvd., Los Angeles)

PACIFIC COAST SURGICAL ASSOCIATION

Los Angeles, February 19–22, 1941. (Secretary—DR. H. GLENN BELL, University of California Hospital, San Francisco)

PAN-PACIFIC SURGICAL ASSOCIATION

Honolulu, 1942. (Secretary—DR. FORREST J. PINKERTON, Young Bldg., Honolulu)

SOUTHEASTERN SURGICAL CONGRESS

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SOUTHERN SURGICAL ASSOCIATION

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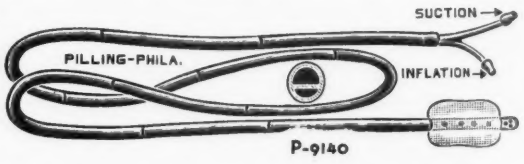

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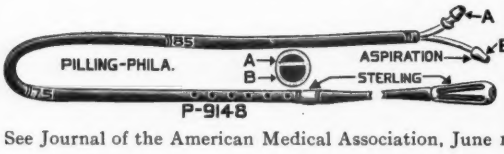

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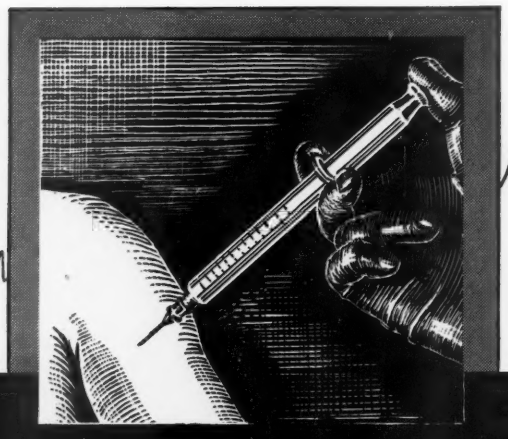

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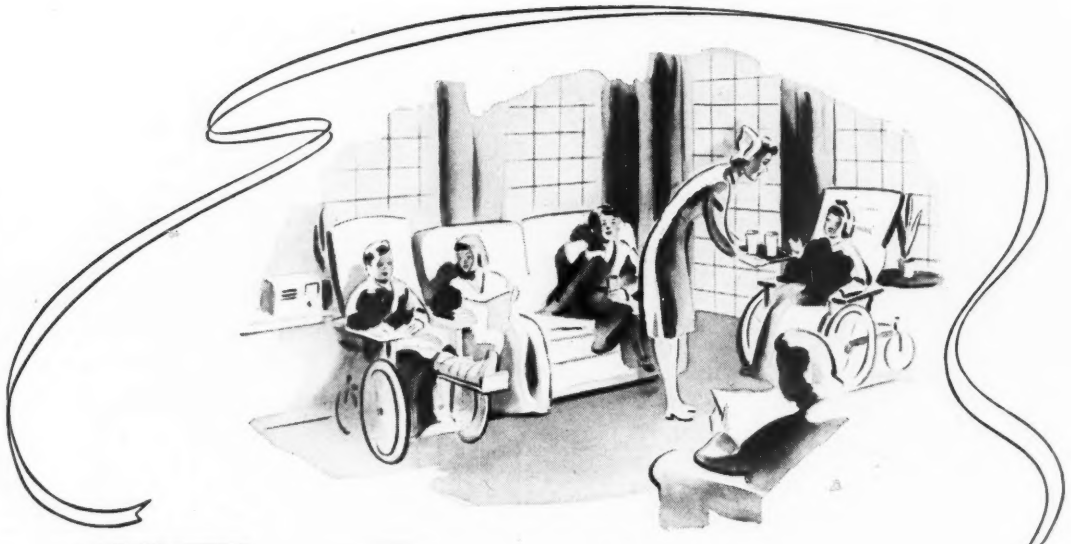

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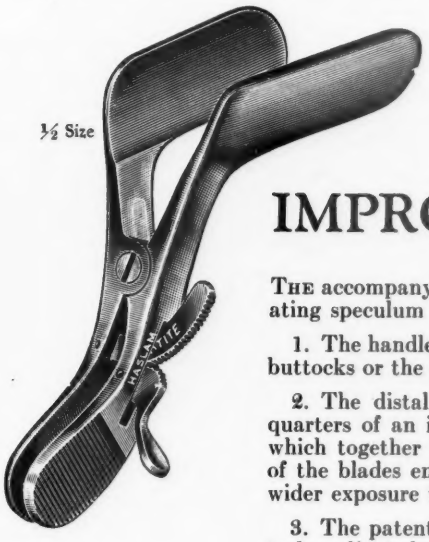

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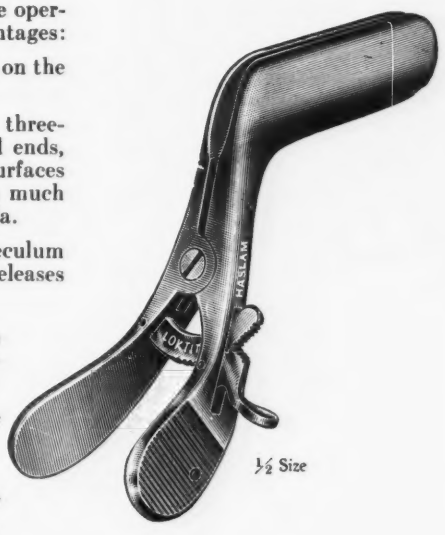

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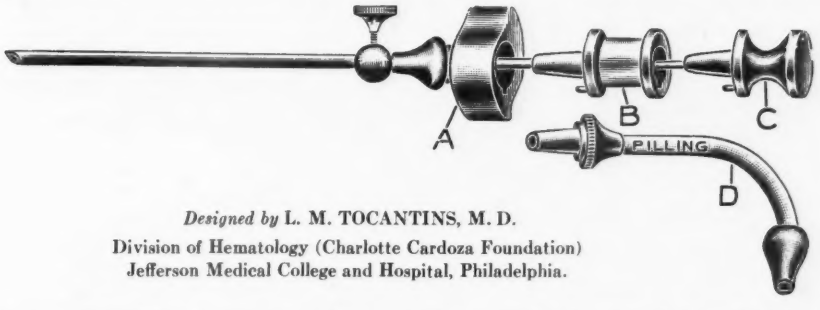

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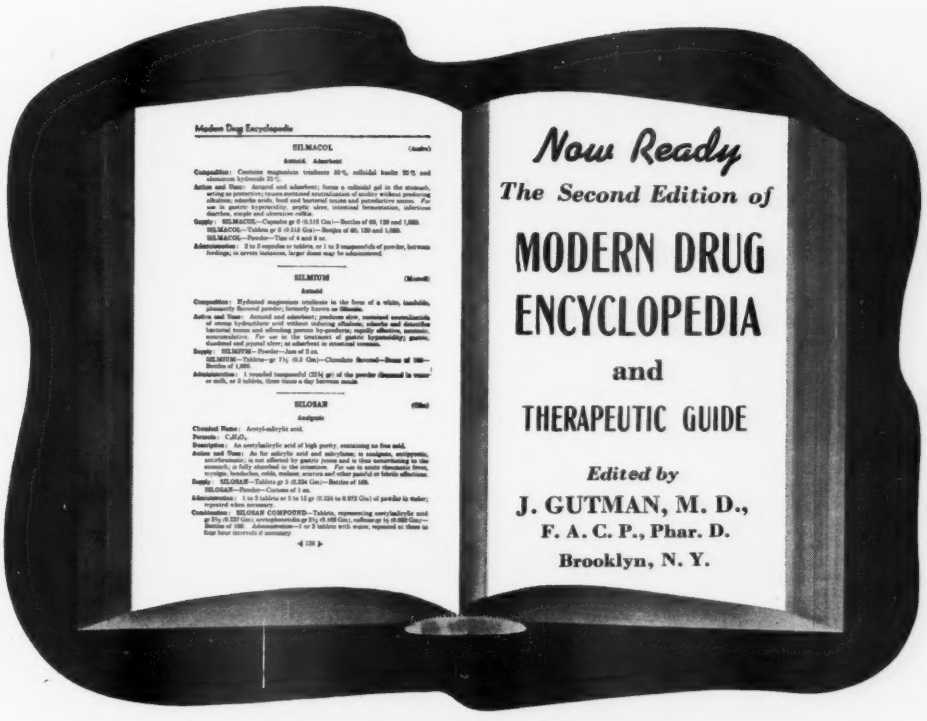

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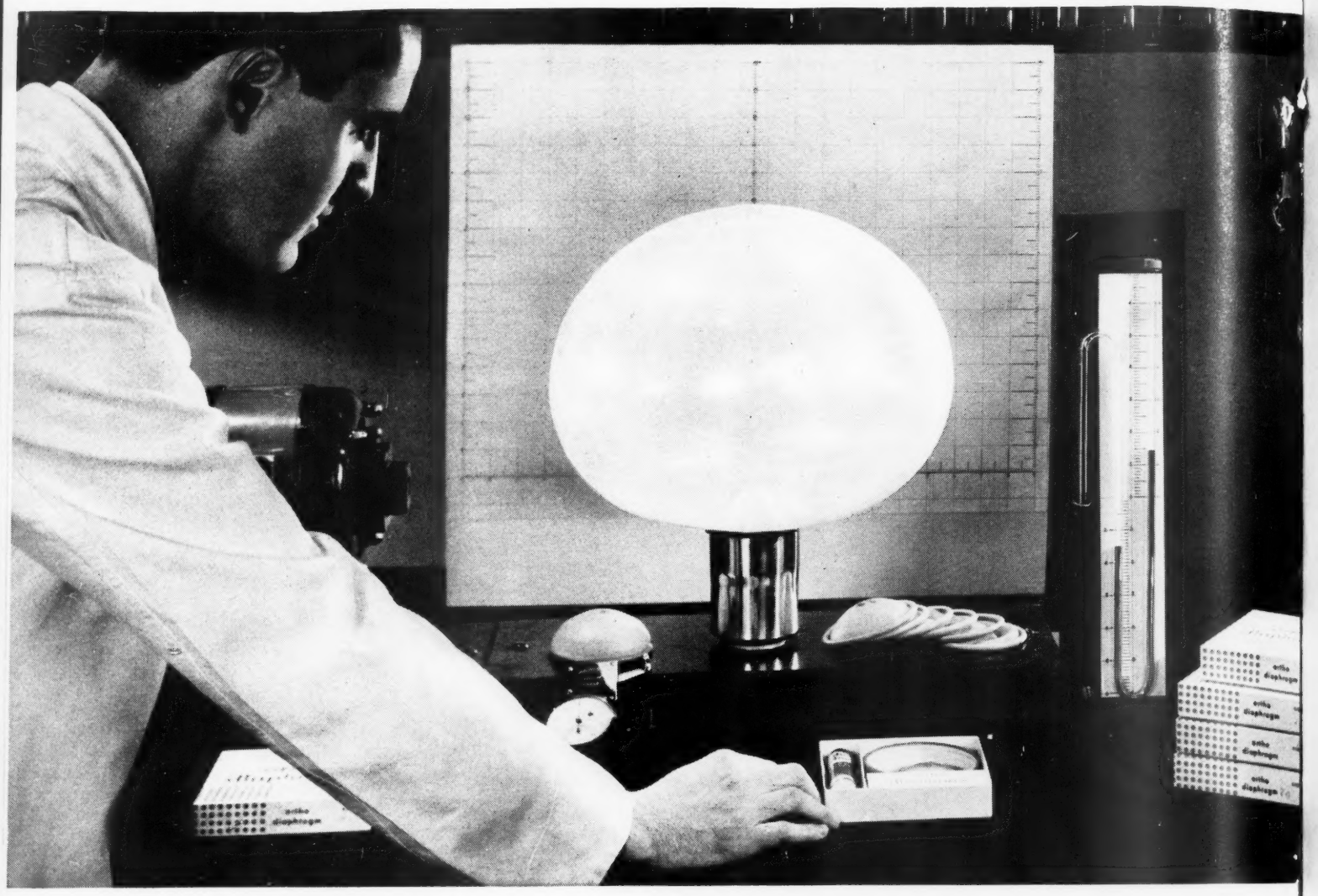

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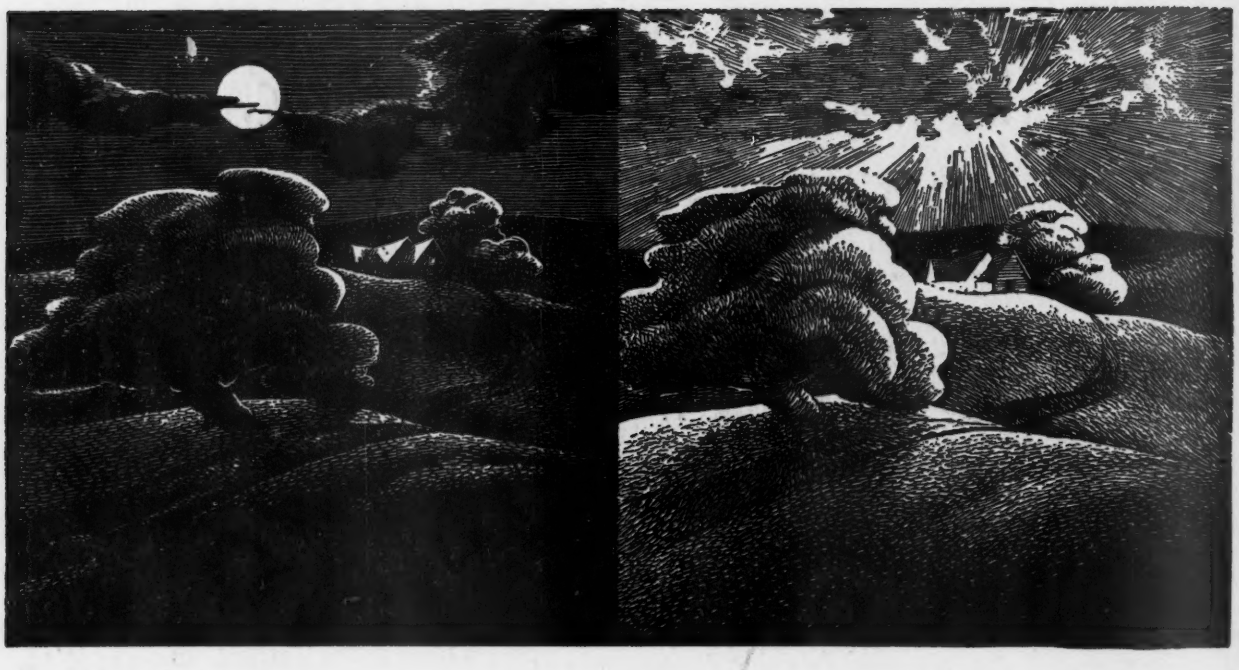
NIGHT and DAY



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